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A DICOTYLEDONOUS WOOD FOUND ASSOCIATED WITH THE IDAHO TEMPSKYAS

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In a recent number of this journal, a series of new interpretations and a summary of our knowledge of the fossil fern *Tempskya* were presented by Andrews and Kern ('47). As a part of their contribution, they described the other plant remains that had been found associated with *Tempskya* in the Cretaceous beds of Idaho. Representatives of the Bennettitales and of the Coniferales were described, and mention was made of a dicotyledonous wood that occurred with these fossils at the Wayan, Idaho, site. This dicotyledonous wood will be described in the present paper in the hope that it will add something to our meager knowledge of the type of plant that lived with, or in the vicinity of, these most peculiar fossil ferns.

The wood specimen was collected near Wayan, Idaho, the site being just east of the Wayan post-office. The source rock is the Wayan Formation which is listed by Wilmarth ('38) as Upper Cretaceous on the basis of the work of Read and Brown ('37). Lower Cretaceous age is also suggested by Wilmarth, and thus it is apparently not possible at the present time to put the formation in its proper place in the Cretaceous without a feeling of uncertainty. The wood is silicified, or partially so, but as can be seen from the photographs, sufficient structure has been preserved so that it is not difficult to make out most of the important features. The thin sections were prepared in the laboratory of Dr. H. N. Andrews and sent to the author for identification. The slides from which the description has been made are Nos. 1482, 1483, and 1484, of the Henry Shaw School of Botany Collections, Washington University, St. Louis.

After considerable study of these slides and of the woods with similar structure to be found in the Harvard Wood Collection, it became evident that, on the basis of the available comparative material, it would be impossible to assign this fossil wood to any living genus or species. At this point Professor I. W. Bailey suggested

that this fossil wood appeared to be similar to a wood he described from the Upper Cretaceous (Colorado Group) of Arizona. A portion of the type specimen of this Arizona fossil was obtained from the U. S. National Museum through the courtesy of Dr. Roland W. Brown and thin sections were prepared from this specimen. *Paraphyllanthoxylon arizonense* Bailey was then compared with the Idaho dicotyledonous wood.

The structure of these two woods is remarkably similar, and, while it must be admitted at the outset that they are not identical, it would be extremely difficult to justify the assignment of this new wood to a genus other than *Paraphyllanthoxylon*. The Idaho wood differs from *Paraphyllanthoxylon arizonense* Bailey in several of its characters but none of these fall outside of the limits set by Professor Bailey in his definition of this form-genus (Bailey, '24).[1] The vessels in the Arizona fossil are fewer in number and larger in cross-section, and the intervascular pitting is inclined to be more abundant, approaching at times a hexagonal pattern. Further, the rays in *P. arizonense* are wider and higher, and the individual cells are more radially elongate. The magnitude and the nature of these variations are well within the range of variability found in individuals of many living species, and thus the differences in the two fossils might be accounted for on the basis of the part of the tree from which the specimen was derived, differences in growth rate, etc. In spite of this, however, it seems appropriate, because of these differences, to describe this new wood as a new species with the hope that the true relationship of these two fossils will be demonstrated in the future as the result of an increasing understanding of fossil woods.

The Idaho fossil wood may be described as follows:[2]

Paraphyllanthoxylon idahoense sp. nov.

Growth Rings:

While it was at first thought that there was some reason to believe that growth rings might be present (fig. 7) it now seems clear that the one isolated area in question is simply a patch of radially narrow septate fibers such as often occur in a number of woods (e. g., *Mespilodaphne sassafras* Meissn.—Lauraceae).

Vessels:

Average diameter: 100 μ; range 60–160 μ. *Average length:* approximately 500 μ. *Arrangement:* wood diffuse, porous; vessels solitary and in short multiples of 2 or 3, occasionally clusters of 3 or 4 (figs. 1 and 2). *Perforation plates:* exclusively simple; angle of end wall oblique to transverse (fig. 6). *Intervascular pitting:* alternate, abundant, circular to elliptical, rather large, i. e. 10–12 μ; orifice slit-like (fig. 6). *Vessel-parenchyma*

[1] Professor Bailey states that the genus was created "for the reception of dicotyledonous woods having combinations of anatomical characters such as occur in mature stems of *Phyllanthus emblica* L., and other structurally similar representatives of the Phyllanthoideae."

[2] The features used are those suggested by Tippo ('41), and the terms are used as defined by the Committee on Nomenclature, International Association of Wood Anatomists ('33).

pitting: elongate-oval (as in the Flacourtiaceae), at least in part (particularly on the erect ray cells). *Tyloses:* abundant, multiple; tightly packed in all, or nearly all, vessels; not sclerotic (fig. 4).

Xylem Parenchyma:

Very sparsely paratracheal (vasicentric). Crystal-bearing strands diffuse *if present.* Although some areas suggest the presence of crystal-bearing parenchyma strands (fig. 4) this could not be conclusively demonstrated. These structures may indicate resiniferous septate fibers or may simply be a product of the degradation of the cell wall.

Xylem Rays:

Abundant; mostly multiseriates. Cells partially filled with some ergastic material (probably phenolic compounds). Multiseriate rays 2–4 cells wide, most of the cells being procumbent with the marginal cells usually erect (fig. 3). Uniseriate rays usually contain a mixture of erect and procumbent cells (fig. 3). Structures suggesting the presence of crystals are occasionally observed.

Fibers:

Septate fiber-tracheids throughout (fig. 5).

Assuming the septate fibers, abundant tyloses, and the nature of the perforation plate to be constant features in the older secondary xylem of the fossil species, the number of families to which it could be related is comparatively few. Study of the woods of the families thus selected revealed a number of genera that contained species closely similar to the fossil, none of which, however, were identical. The similarities and differences between the fossil and these living species are summarized in Table I. Only one species of each genus is listed although in the case of *Canarium* and *Beilschmiedia* there are other species that are equally similar.

Of the six families included in the table, the fossil finds its best counterparts in the Anacardiaceae, Burseraceae, and the Euphorbiaceae. The absence of radial gum ducts in the fossil, however, reduces the possibility of it being either a *Koordersiodendron* or a *Garuga,* although in most other features the similarities are quite striking. It is, of course, possible that the fossil had gum ducts and, by chance, none are contained in the specimen studied. This possibility should certainly be recognized, but it is obvious that it is impossible to go beyond this point and still justify one's methodology.

Bridelia minutifolia Hook. (Euphorbiaceae) possesses a number of features in common with the fossil, and its ray type may not be too dissimilar to be an ontogenetic phase of the fossil ray type. The same applies to *Phyllanthus emblica* L., but in both cases it is evident that the living wood is by no means identical with that of the fossil. The Lauraceous forms are quite similar but the inflated secretory cells in the rays eliminate these from our consideration. *Kirkia acuminata* Oliver (Simarubaceae) may be rejected because of its ray type, and while the rays of

TABLE I

A COMPARISON OF THE FOSSIL WOOD WITH SIMILAR LIVING SPECIES

Possible Relative	Vessels					Fibers	Xylem parenchyma	Xylem rays	Other Features
	Approximate length (microns)	Form and arrangement	Perforation plate	Intervascular pitting	Vessel-ray pitting				
ANACARDIACEAE									
Koordersiodendron pinnatum Merr.	480	X[1]	X	X	X	X	X[2]	—[3]	Radial gum ducts present; ergastic material in the rays and fibers very similar to that of the fossil
Schinopsis balansea Engl.	300	—	X	X	X	X[4]	—	—	Radial gum ducts present
Mauria simplicifolia DC.	300	—	X	X	X	X[4]	X	—	Abundant strands of crystal-bearing parenchyma present
BURSERACEAE									
Garuga pinnata Roxb.	310	—	X	X	X	X	X	X	Radial gum ducts present
Canarium rufum Benn.	330	—	X	X	X	X	X	—	Radial gum ducts present
EUPHORBIACEAE									
Phyllanthus emblica L.	480	—	X	X	X	X	X	—	Tyloses in vessels infrequent
Bischofia javanica Blume	420	X	X	X	X	—[5]	X	—	Walls of ray cells "beaded"
Bridelia minutifolia Hook.	480	X	X	X	X	X	X	—	Tyloses in vessels infrequent; strands of crystal-bearing parenchyma present
LAURACEAE									
Beilschmiedia roxburghiana Nees	410	—	X[6]	X	X	X	X[2]	—	Secretory cells present
Mespilodaphne sassafras Meissn.	360	X	X	X	X	X	X[2]	—	Secretory cells present
SIMARUBACEAE									
Kirkia acuminata Oliver	350	X	X	X	X	X	X	—	
VERBENACEAE									
Petitia domingensis Jacq.	320	—	X	X	X	X	X	X?	

[1] (X) signifies that structure is identical with fossil.
[2] Paratracheal parenchyma more abundant than in fossil.
[3] (—) signifies that structure differs from the fossil.
[4] Not all fibers are septate.
[5] Libriform septate fibers.
[6] Occasionally scalariform.

Petitia domingensis Jacq. (Verbenaceae) are more similar, the structure and arrangement of the vessels throw doubt on this form.

Some of the characteristics of the fossil can be found in families other than those listed above. For example, in the family Urticaceae the genera *Laportea* and *Pipturus* have abundant tyloses in the vessels, simple perforation plates, and the fibers are all septate. Numerous other features of the woods (storied cambium, wood parenchyma distribution, etc.) exclude the possibility of assigning the fossil to any of these families, and the inclusion of these and like forms in the table would have contributed nothing to our understanding of the fossil so they were omitted. It is clear, from the table and from these remarks, that this fossil has a combination of characters which can be similarly approximated in a number of dicotyledonous families. In view of this it appears unwise to suggest any specific family to which the fossil should be assigned, but it should be noted that the Anacardiaceae, Burseraceae, and the Euphorbiaceae represent the best possibilities.

All the species listed in the table are tropical or sub-tropical forms, but they represent both hemispheres and a variety of habitats. *Schinopsis* is found in swampy river bottoms, *Mauria* in highland areas; *Petitia* is confined to the West Indies, *Bischofia* to the Indo-Malayan region, etc. Little light, therefore, is thrown on the possible habitat of this cretaceous dicotyledon by the ecological and phytogeographical relations of the similar living species, although the implication is that it was not a temperate or cold temperate form. Hence, the identity, real affinity, and the greater part of the significance of this wood remain obscure, but the knowledge of the existence of a dicotyledon of this type among the remains of *Tempskya* is an interesting addition to our rather scant collection of facts regarding the associates of this extinct fern type.

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Explanation of Plate

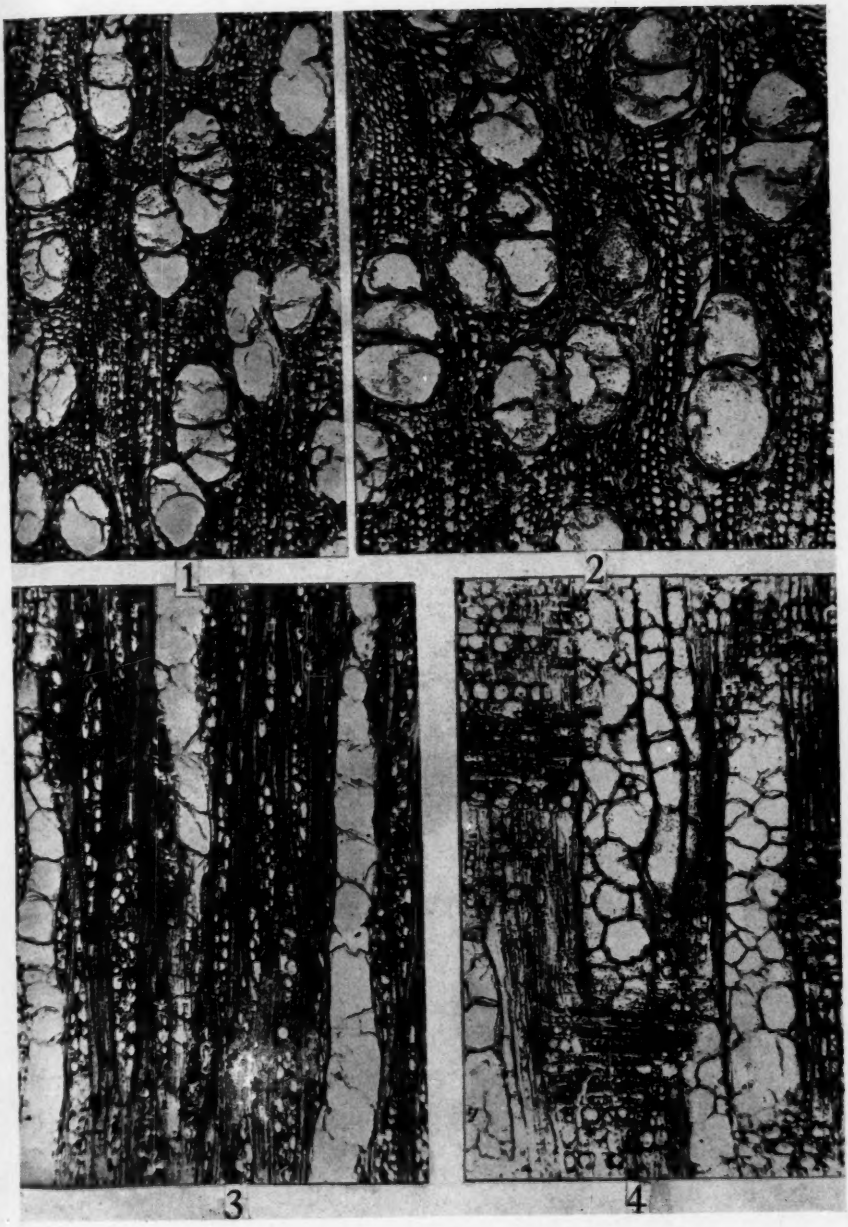
PLATE 1

Paraphyllanthoxylon idahoense

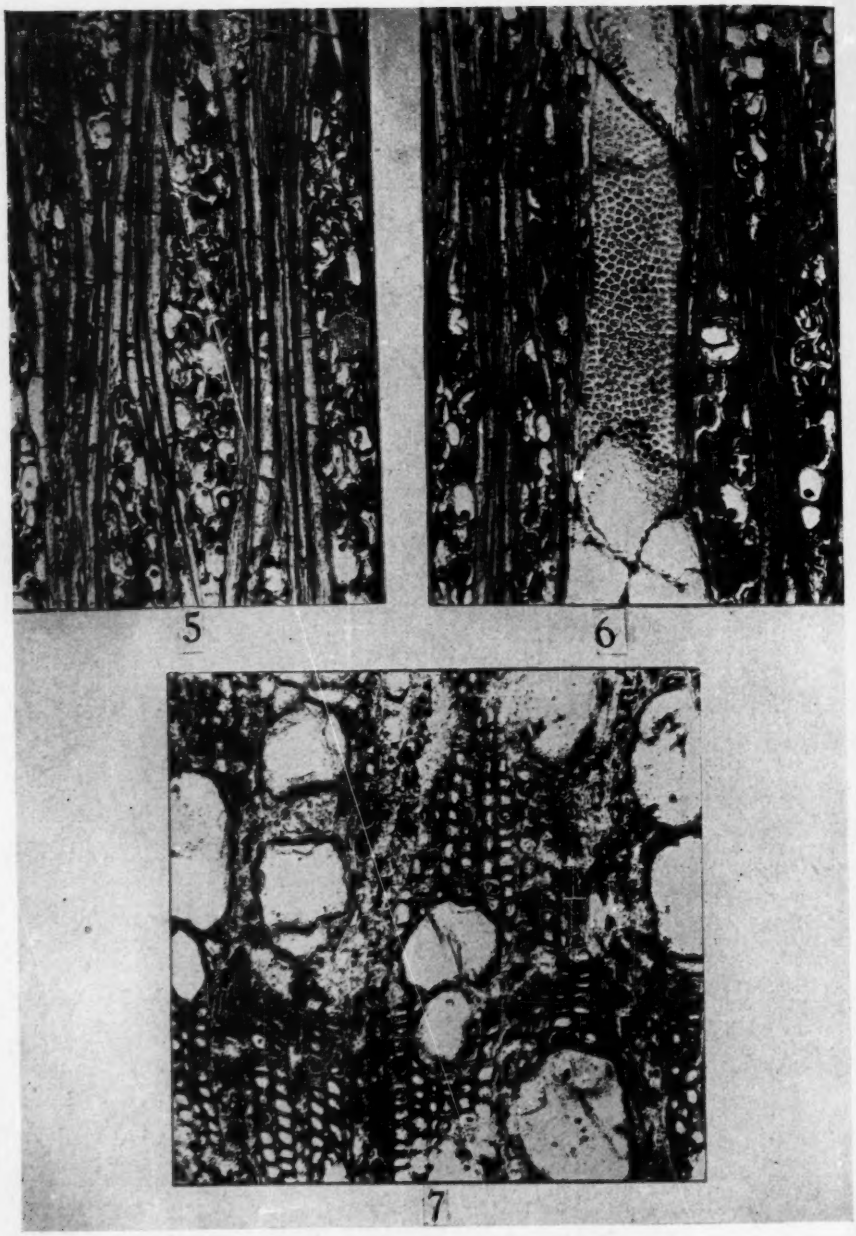
Figs. 1 and 2. Transverse sections showing the form and arrangement of the vessels and fibers. From slide No. 1482, × 100.

Fig. 3. Tangential section showing ray structure. From slide No. 1483, × 100.

Fig. 4. Radial section showing the abundant tyloses in the vessels and the questionable crystal-bearing parenchyma strands. From slide No. 1484, × 100.



SPACKMAN—PARAPHYLLANTHOXYLON IDAHOENSE



SPACKMAN—PARAPHYLLANTHOXYLON IDAHOENSE

Explanation of Plate

PLATE 2

Paraphyllanthoxylon idahoense

Fig. 5. Tangential section showing septate fibers and the details of the multiseriate rays. From slide No. 1483, × 150.

Fig. 6. Tangential section showing the details of the characteristic vessel type. From slide No. 1483, × 150.

Fig. 7. Transverse section showing the patch of radially narrow fibers which was at first thought to be part of a growth ring. From slide No. 1482, × 150.

THE USES OF HEVEA FOR FOOD IN RELATION TO ITS DOMESTICATION

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The domestication of plants involves many factors about which there is little direct information. Many of our most useful plants originated so long ago that we do not know their exact geographical origin or the plant or plants from which they were derived. Modern man, in his short span of keeping accurate records, can turn to few examples which offer the complete history of the domestication of a plant. *Hevea* is one plant which is being domesticated in a modern world by reason of its recent value as the world's most economical rubber producer. Its history is so short as scarcely to have changed the plant from its role as a wild jungle tree; yet it will serve as an example from which we may gain further insight into ancient plant domestication.

How do plants become domesticated? To the uninitiated this question may seem too simple for serious consideration. But if it is so simple why are our best research men still in a controversial quandry regarding the origin of maize and most of our other cereals? We may say that plants become domesticated by man through countless generations of cultivation and conscious or unconscious selection of the best-yielding or most adaptive individuals for further propagation. As far as it goes, this may be true but it does not take into account the effects that wild forage animals may have had upon domestication. Little is known of the effect of gradual and catastrophic changes in ecology caused either by man or nature. Seldom can all of the possible factors concerning seed and plant distribution be accurately reconstructed. We must contend with such difficult factors as long-past chance hybridizations and mutations in a plant's history of domestication.

The domestication of a wild plant is brought about by its being taken from its native habitat and reproduced for successive generations under man-modified conditions. Some species have been cultivated in different regions for different reasons at different times. What has happened when two or more of these closely related strains have been brought together? Evidence of such appears in maize literature (Anderson, '46). There are distinct strains of flax, one for seed oil, the other for fibre, certainly an important factor to be considered. The nature of a wild plant may become so changed through the long and complicated process of domestication that it can no longer survive without the aid of man. What would become of the domesticated plants which must rely on man for survival and without which man could not survive?

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How has *Hevea* become domesticated? As a rubber-producing plant, it was taken from the lower Amazon valley to the Far East, seventy-one years ago, into a completely new environment without its indigenous diseases and pests. *Hevea* is a tree crop requiring about ten to fifteen years from seed germination to proven optimum rubber yield. Through selective seed propagation and vegetative budding the average annual yields of seedling trees have been increased from about 350 pounds per acre to above 1500 pounds for bud-grafted trees. This is a remarkable improvement. But, one can scarcely call *Hevea* a highly domesticated plant when comparing its generations of cultivation with those of potatoes or the cereals.

The story of *Hevea* domestication has been often repeated in literature during the past few years. Its most recent chapter concerns the return of the tree to its original home (back to its indigenous diseases and pests) for the development of a Latin American rubber industry through the cooperative sponsorship of the U. S. Department of Agriculture and various Latin American countries (Brandes, '47). This is not the entire history of domestication through which *Hevea* has passed and is passing. Nor is its domestication wholly concerned with a basis of drop-by-drop rubber latex yield from the incised bark.

The domestication of a semi-wild *Hevea* as a food source also must be taken into consideration. There are indications that in its Amazonian home the *Hevea* tree may first have been known to the pre-Columbian aborigine as a nut tree. Probably from acquaintance with *Hevea* as a source of food, the Indian in time learned that certain of these trees produced, through injury to the bark, a substance which could be made into waterproof objects. No doubt one of these objects at some time fell into the fire and the material was seen to burn readily. From this he may have learned that the latex when placed in smoke would coagulate rapidly into a more durable material than when allowed to coagulate naturally. This substance, latex, in its coagulated form, rubber, was destined to overshadow the trees' local value and use for a food.

The celebrated Amazonian plant collector, Richard Spruce, gives the following account, quoted by Bentham (1854):

> Siphonia [Hevea].—This genus seems abundant throughout the Amazon and its tributaries, but not all the species yield caoutchouc (or Xeringue, as it is here called) of good quality. . . . The wood in all is soft, soon decaying. The seeds are an excellent bait for fish. Macaws eat them greedily, but to man and quadrupeds they are poisonous in a fresh state. The Indians on the Uaupés render them eatable in this way: after being boiled twenty-four hours, the liquor is strained off, and the mass that remains has something the colour and consistence of rice long boiled. Eaten along with fish it is exceedingly savoury. —R. Spruce, MS.

Baldwin ('47) has confirmed the use of *Hevea* seeds for food by the Indians along the Río Negro. It appears also that the seeds of *Cunuria*, a genus closely allied to *Hevea* (and reputed to have hybridized with it), are prepared and eaten by the Indians of the same general region according to Spruce, as reviewed by Baldwin and Schultes ('47).

The pre-Columbian ancestry of both the Carib and later the Arawak Indians inhabiting the great Amazon tributary, the Río Negro, indicates several centuries

of river transportation and primitive agriculture to have existed within the Amazon valley (Radin, '42) and that, furthermore, intercourse existed between the Río Negro and the Orinoco drainage via the Casiquiare. It is becoming evident that a number of plants, of which I feel the "Peach-palm," *Guilielma Gasipaes* (HBK.) Bailey, may prove to be the classic example, may have been distributed from their native homes on the eastern slopes of the Andes through the Amazon valley (Seibert, '47). By way of the Río Negro and Orinoco they eventually became introduced through the West Indies to Central America. As in *Guilielma*, where seed viability lasts for a long time and where growth requirements are not so exacting, a distribution of this sort might quite likely have been carried on by the Indians. Furthermore, *Guilielma* was and is a more important tree in the economy of these Indians than is usually realized. Its fruit is a source of abundant and nutritious food; its wood furnishes one of the finest materials for bows and arrow-points known; its spines make good needles; its leaves, a usable thatch; and the heart of the palm, an excellent food.

In the case of *Hevea*, seed viability lasts only a few days, or at most a few weeks when specially packed. Although establishment of the seedlings is extremely difficult under all but the best of conditions, nevertheless within the Amazon valley itself *Hevea* was and is often transplanted from jungle to doorstep by many an Indian. As a food source in that region it was an important plant where native food plants are exceedingly rare, but it probably was not worth the effort transporting it to regions where food was no such problem as on the Río Negro. As a rubber-producing plant the Indian, in all probability, relied not on *Hevea* but on *Castilla*, which for his needs and crude methods of tapping was far superior. *Castilla* inhabited Central America, the West Indies, and the Amazon valley, so he had no need for transporting a rubber plant—or did he have something to do with the distribution of *Castilla* as well?

Schultes ('45), from individual observations in the Río Negro region, confirms the evidence from herbarium material that this region of the Amazon valley contains more species of *Hevea* and with greater variability within species than any other region thus far known. Transportation being difficult except along streams, collections from that area have largely been obtained from camp-sites, the edges of villages, and from clearings easily accessible. It is quite likely that our collections of *Hevea* from this and other regions are composed of much material originally planted by the Indians and from progeny of those planted trees, hybridized with the local jungle trees, which have sprung up in ancient and recent clearings.

Man along the Amazon has unconsciously and inconspicuously been changing the natural habitat of *Hevea* along the main waterways for centuries. He has made conditions under which interspecific hybridization within *Hevea* has been greatly facilitated and encouraged over large areas. He has aided in obscuring some distributional patterns along the rivers and certainly has contributed to many

perplexing cases of introgression (Seibert, '47). Through this he probably has done more than we realize to cause the extreme variability of *Hevea* found along the Río Negro. As far as I am able to learn from material seen, this variability reaches a very high degree in *Hevea pauciflora* (Spruce ex Benth.) Muell.-Arg. *H. pauciflora* appears as a major constituent in most of the hybrids and hybrid swarms along the upper Amazon proper and the Río Negro, evidently having hybridized with most of the other species of that region. This species is causing the most taxonomic discordance and it appears to have the greatest variation in seed size (Seibert, '47). It may be possible that *H. pauciflora* was the species which the Indians preferred as a nut tree and consequently attempted most often to domesticate. The rubber is very poor, and in hybrids originating from it as one parent, this characteristic seems to predominate. *H. pauciflora* is outstanding, however, in its resistence to the virulent South American Leaf Blight, *Dothidella Ulei* P. Henn. The Río Negro, though abundant in species and variations, is not known as a superior rubber-producing area, though it may prove to be highly significant as a region of outstanding disease-resistant strains.

Hevea has aided man in his advance in civilization. A study of its early history as a wild and cultivated nut tree is resulting in information useful in the task of improving commercial planting material of the *Hevea* rubbertree. It is not too optimistic to prophesy that modifications of its original jungle use may again be taken up as by-products of commercial plantings. Further experimental work is needed to test the qualities of these by-products. The seed kernels contain a high percentage of oil which is chiefly used in soap, but, being quick-drying, would also be of value in the paint industry. Stock feed and fertilizer may be manufactured from the remaining seed pulp (Jamieson, '43).

SUMMARY

1. Through its value as a food plant to the Indians of the Río Negro region, it appears that *Hevea* became a semi-domesticated tree.

2. Its domestication along the major waterways in clearings, edges of villages, and camp-sites followed a pattern of conscious or unconscious selection for seed production.

3. The planting of certain species in the vicinity of other wild species substantially aided the process of interspecific hybridization.

4. The spot-clearing and shifting type of agriculture practiced along the rivers for centuries resulted in types of habitats ideal for the growth and development of interspecific hybrids and hybrid swarms.

5. Once established in clearings the mature hybrids and introgressive hybrids are (at least in part) capable of competing with the encroaching second growth.

6. Several centuries of this slow process seem to have played a conspicuous part in the resultant hodge-podge of variables turning up as representative collections of *Hevea* from the Río Negro.

7. The "Peach-palm, *Guilielma Gasipaes*, may prove to be a classic example of the extent to which a tree has become domesticated in the Amazon valley, passing from Indian tribe to Indian tribe, from region to region, eventually reaching the West Indies and Central America.

8. From present evidence it appears that *Hevea pauciflora* has been the species of *Hevea* most cultivated by the Indians of the Río Negro and upper Amazon.

9. The Río Negro region is not outstanding as a region of high rubber yield or quality.

10. The past history of semi-domestication of *Hevea* in the Río Negro region may be significant in having strengthened disease resistance within certain species of that region.

11. The seeds of *Hevea* are a potential source of economic products useful to man.

12. Many of our cultivated plants probably had similarly complex histories.

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THE USE OF GLANDS IN A TAXONOMIC CONSIDERATION OF THE FAMILY BIGNONIACEAE[1]

R. J. SEIBERT[2]

Some genera of the family Bignoniaceae are important in the lumber industry of tropical regions, and many others hold unlimited horticultural possibilities. From a practical standpoint, therefore, horticulturists, foresters, and systematists need means of recognizing this multitude of conspicuous tropical plants. The use of floral characters in generic delimitation has been inadequate. Fruit characters have been satisfactory but it is only rarely that fruiting specimens are collected, and many species have been dubiously placed generically because the fruit has been incompletely studied or not observed. Too little attention has been given to vegetative characters in a taxonomic consideration of the Bignoniaceae.

Many bignoniaceous representatives are deciduous or flower before the appearance of leaves. Particularly in the lianas, the leaves vary with the part of the plant from which they are growing. More often than not, leaf specimens collected from the top of the plant, climbing through the trees, may be small and delicate while those near the base of the same plant are apt to be large, leathery, and of a different shape. It frequently is difficult to realize that the same species, in fact the same plant, could produce such unlike leaves.

As early as 1864, Bureau[3] recognized and discussed various types of glands in the family, but made no use of them in any practical way. K. Schumann[4] made some beginnings in the taxonomic utilization of the glands, but it was Sandwith[5] who first successfully used them as key characters and as significant features in specific descriptions. His ideas have been critically examined and found to be most practical in application.[6]

More types of glands are found in the lianas in general than in the tree members of the family. The tribe Bignonieae, representing most of the lianas, may be divided into two groups on the basis of glands alone. One group has them located at the nodes between the petioles while the other group has no evidence of glandular regions at the nodes but, rather, has more or less distinct ridges between the petioles. Both functional and apparently non-functional glands are found. In some instances the secretions are quite odoriferous. Occasionally secretions from the glands, particularly those in the axils of the lateral leaflet veins and on the

[1]This paper was prepared in connection with studies carried on while the writer was a graduate student at the Missouri Botanical Garden.

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[6]Seibert, R. J. The Bignoniaceae of the Maya area. Carnegie Inst. Washington, Publ. 522:375–434. 1940.

calyx, have been found to permit growth of specialized fungi. It seems safe to say that glands, as represented in the family Bignoniaceae, may be utilized to advantage in a taxonomic treatment. Certain types of glands fit in harmoniously with the present system of classification based on the fruit. In combination with other characters they prove useful in generic as well as in specific delimitation, greatly facilitating identification in sterile material.

TYPES OF GLANDS REPRESENTED IN THE FAMILY BIGNONIACEAE

INTERPETIOLAR GLANDS:

Fields of rather closely crowded glands may be found on either side of the stem, at the nodes between the petiole bases, rarely slightly above them (pl. 3, figs. 1–3). The glands are somewhat saucer-shaped and depressed in the stem tissue, giving a pitted appearance usually discernible to the naked eye. They are multicellular structures attached to the epidermis by a single very large cell (pl. 6, fig. 1). Apparently this attachment cell had its origin as an epidermal cell which became much enlarged and pushed up from the epidermis proper.

The size and number of interpetiolar glands in the fields vary considerably, depending on the genus. Interspecific variation within some genera is sufficiently constant to be of material taxonomic aid. These fields are usually most apparent on young branchlets, and frequently are completely obliterated in the second or third year. However, in such genera as *Ceratophytum* and *Pachyptera* they may become more conspicuous in the older plants, in which case the tissue grows partially around them, producing deep pits or depressions.

Interpetiolar glands form a basis for dividing the lianas into two subdivisions. With very few exceptions each species within a particular genus has a rather characteristic field as regards size, shape, and number and size of the glands. Only in the genus *Neomacfadya* are these glands difficult to see, and there one is often compelled to search several nodes with the aid of a lens.

The following representative genera are characterized by having interpetiolar glands:

Arrabidaea	*Macfadyena*	*Potamoganos*	*Scobinaria*
Ceratophytum	*Neomacfadya*	*Pseudocalymma*	*Tanaecium*
Lundia	*Pachyptera*	*Saldanhaea*	

NEURO-AXILLARY GLANDS:

Glandular structures may be located in the axils of the lateral veins, on the lower surface of the leaves or leaflets. In structure and diversity they are quite similar to those found on the leaves within the Apocynaceae and Lauraceae. In the Bignoniaceae they are not characteristic of all species within a particular genus, and hence they frequently may be used to advantage in specific delimitation.

Two distinct types of neuro-axillary glands are represented with considerable variation within each type. In a few instances some border-line conditions have been noted grading more or less into each other.

Domatia or *Coeliac Glands.*—These are modified cavities in the axils of the lateral veins (pl. 4, figs. 1, 2). They frequently furnish shelters for scale and other small insects. Depending on the species, they run the gamut from a tufted-pubescent axil to a very deep cavity with a ciliated orifice. Their structure is quite constant within the species and usually they are easily seen with the naked eye. In such few cases as characterized by *Arrabidaea obliqua* the cavity may be much in evidence on the upper surface of the leaflet as a dome-shaped protuberance (pl. 4, fig. 3).

Glandular Fields.—Areas of closely crowded glands are sometimes immersed in the tissue (pl. 4, figs. 4, 5). Morphologically they are similar to the interpetiolar glandular fields (pl. 7, fig. 1), and frequently they are secretory structures. The secretions may be odoriferous, as in *Anemopaegma Chamberlaynii,* where a skunk-like odor is emitted, or as the "bejuco de ajo" (*Pseudocalymma* sp.) which emits a strong garlic odor. It is to be noted that a fungus was found growing in the odoriferous secretion of the glands of *Anemopaegma Chamberlaynii.*

Representative species characterized by having neuro-axillary domatia or glandular fields are:

Amphilophium paniculatum (L.) HBK.
Anemopaegma Chamberlaynii (Sims) Bur. & K. Schum.
Arrabidaea candicans (L. C. Rich.) DC.
Arrabidaea floribunda (HBK.) Loes.
Arrabidaea obliqua (HBK.) Bur.
Catalpa (all species)
Ceratophytum tobagense (Urb.) Sprague & Sandw.
Chodanthus puberulus Seibert
Cydista aequinoctialis (L.) Miers
Cydista diversifolia (HBK.) Miers
Cydista heterophylla Seibert
Cydista pubescens Blake
Onobualcos fissa (Loes.) Sandw.
Parmentiera (all species)
Pseudocalymma laevigatum (Bur. & K. Schum.) Semp. & Kuhlm.
Pseudocalymma macrocarpum (Donn. Sm.) Sandw.
Pyrostegia venusta (Ker) Miers
Spathodea campanulata Beauv.
Tabebuia pentaphylla (L.) Hemsl.
Tecoma stans (L.) HBK.
Tynanthus guatemalensis Donn. Sm.

PETIOLAR GLANDS:

A field of conspicuous glands may be found at the terminal end of the petioles below their junction with the petiolules (pl. 3, figs. 4, 5). They are the rarest type of gland found in the family and, being represented only in *Pachyptera* and *Pseudocalymma,* they serve as an excellent means of recognizing these two genera when only sterile material is at hand. It is to be noted that both these genera are also characterized by very prominent interpetiolar glands.

CALYX GLANDS:

Submerged or somewhat impressed functional glands are usually located on the upper half of the calyx tube or on the lobes (pl. 5, fig. 1), usually arranged in rows. They are quite conspicuous in living material and exude large globules of colorless, viscous liquid. In structure they generally are like those found in the axils of the lateral leaflet veins or on the stems between the petioles, that is, multicellular saucer-shaped glands attached by a single very large cell. However, in the large, inflated calyces of *Callichlamys latifolia* the glands are exceptionally large, completely submerged, and attached by a considerable number of rather

large cells, in no way as conspicuous as the single large attachment cell of the other types (pl. 7, fig. 2).

Microtome sections made through the calyx glands of *Callichylamys latifolia* showed them to be infected by a member of the Melanconiales. The fungus appears to grow well in the material exuded, and hyphae have been traced down through the gland into the attachment cells. Nothing more than the gland itself was seen to have been infected.

The following genera may be said to be characterized by conspicuous glands on the calyx:

Adenocalymma	*Crescentia*	*Memora*	*Scobinaria*
Anemopaegma	*Cydista*	*Pachyptera*	*Tanaecium*
Astianthus	*Distictella*	*Pleonotoma*	*Tecoma*
Callichlamys	*Enallagma*	*Paragonia*	
Campsis	*Martinella*	*Pithecoctenium*	
Ceratophytum	*Macfadyena*	*Roentgenia*	

COROLLA GLANDS:

Partly immersed saucer-shaped glands are sometimes found in rows near the base of the corolla lobes (pl. 5, fig. 2). They may be either on both sides or at the center of the lobe base, and may extend a short distance down the throat. When present, they are very conspicuous but are found only in a few genera, as characterized by *Pachyptera*, *Pleonotoma* and *Memora*. In *Adenocalymma* corolla glands are confined only to a few of the species, best exemplified by *A. inundatum* Mart.

PSEUDOSTIPULAR GLANDS:

Partly immersed glands on the pseudostipules may be found on nearly all species in which pseudostipules appear. The glands are dispersed with no definite arrangement in rows or fields. Taxonomically they appear to be of little use.

PELLUCID GLANDS:

These glands, located on the leaflets, are quite similar to the familiar pellucid glands on the leaves of the Rutaceae. They are yellowish orange when viewed under a lens. By holding the specimen to the light they may be seen as numerous, small but conspicuous, translucent spots. Only four genera are characterized by having pellucid glands: *Amphilophium*, *Pithecoctenium*, *Pyrostegia*, and *Stizophyllum*.

SCATTERED GLANDS:

Scattered impressed saucer-shaped glands are mostly found on the surface of the leaflets. There is no definite arrangement except that they are usually close to the main veins (pl. 4, fig. 3). They frequently are a constant character within a species.

GLANDULAR SCALES:

Minute scales may be found on stems, petioles, leaves, calyx, corolla, ovary and fruit, and are responsible for the "lepidote" condition so frequently encountered in the Bignoniaceae. So far as is known, they never are secretory. The glandular (lepidote) scales are multicellular structures attached to a slightly modified

epidermal cell or cells (pl. 6, figs. 2, 3). They may be subdivided into three types as follows:

Sessile.—Somewhat immersed or resting on the surface of the tissue and attached to an epidermal cell.

Stipitate.—Attached to the epidermis by a short, few-celled stalk. This type is rare, being most conspicuously represented in the genus *Mussatia*, where they are found on the outer corolla surface.

Punctate.—In maturity, natural removal of somewhat immersed sessile glandular scales leaves a punctate condition found on leaflet surfaces of a number of species.

Glandular scales are most conspicuous on leaflets (pl. 4, fig. 4; pl. 6, fig. 3), ovaries (pl. 6, fig. 2), calyces, and especially corollas. When seen on the outer surface of the corolla one may expect to find that every species of that genus will have lepidote corollas. The following genera are characterized by glandular (lepidote) corollas:

Anemopaegma	*Crescentia*	*Martinella*	*Pleonotoma*	*Stizophyllum*
Callichlamys	*Cydista*	*Mussatia*	*Pseudocalymma*	*Tecoma*
Clytostoma	*Enallagma*	*Neomacfadya*	*Roentgenia*	

CAPITATE GLANDULAR HAIRS:

Hairs having multicellular capitate glands at the apex may be located on stems, petioles, leaflet veins, calyces, and staminodia (pl. 7, figs. 3, 4, 5). In *Jacaranda* they are always located on the staminodia, and by the relative length, density, distribution, and placement of these hairs on the staminodia it is possible to distinguish many of the species of this genus. Usually they are most densely disposed in the region nearest the anthers where they may serve as nectaries to aid in insect pollination.

Other than in *Jacaranda*, few genera have capitate glandular hairs, and then only on isolated species. *Arrabidaea mollissima* (HBK.) Bur. & K. Schum. may be cited as characteristically having them on the young branchlets, petioles, and inflorescence branches, where they are scattered throughout the other shorter, normal pubescence.

Explanation of Plate

PLATE 3

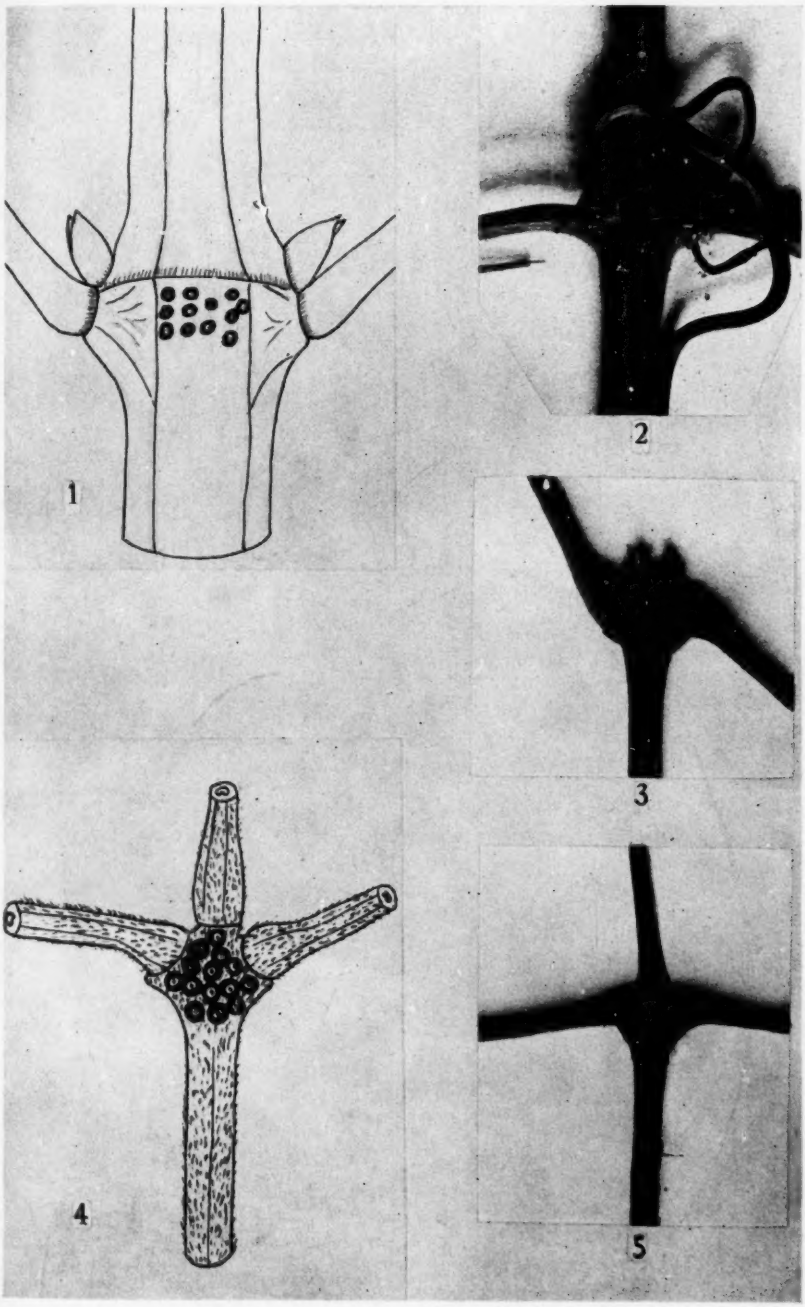
Fig. 1. Interpetiolar glands at the node of *Pseudocalymma* sp.

Fig. 2. Interpetiolar glands at the node of *Arrabidaea Blanchetii* DC.

Fig. 3. Interpetiolar glands at the terminal node of a young branch of *Pachyptera Kerere* (Aubl. emend Splitg.) Sandw.

Fig. 4. Petiolar glands of *Pachyptera Kerere* showing their position at the terminus of the petiole below the junction of the petiolules.

Fig. 5. Petiolar glands of *Pachyptera Kerere.*



SEIBERT—GLANDS IN THE BIGNONIACEAE

Explanation of Plate

PLATE 4

NEURO-AXILLARY GLANDS

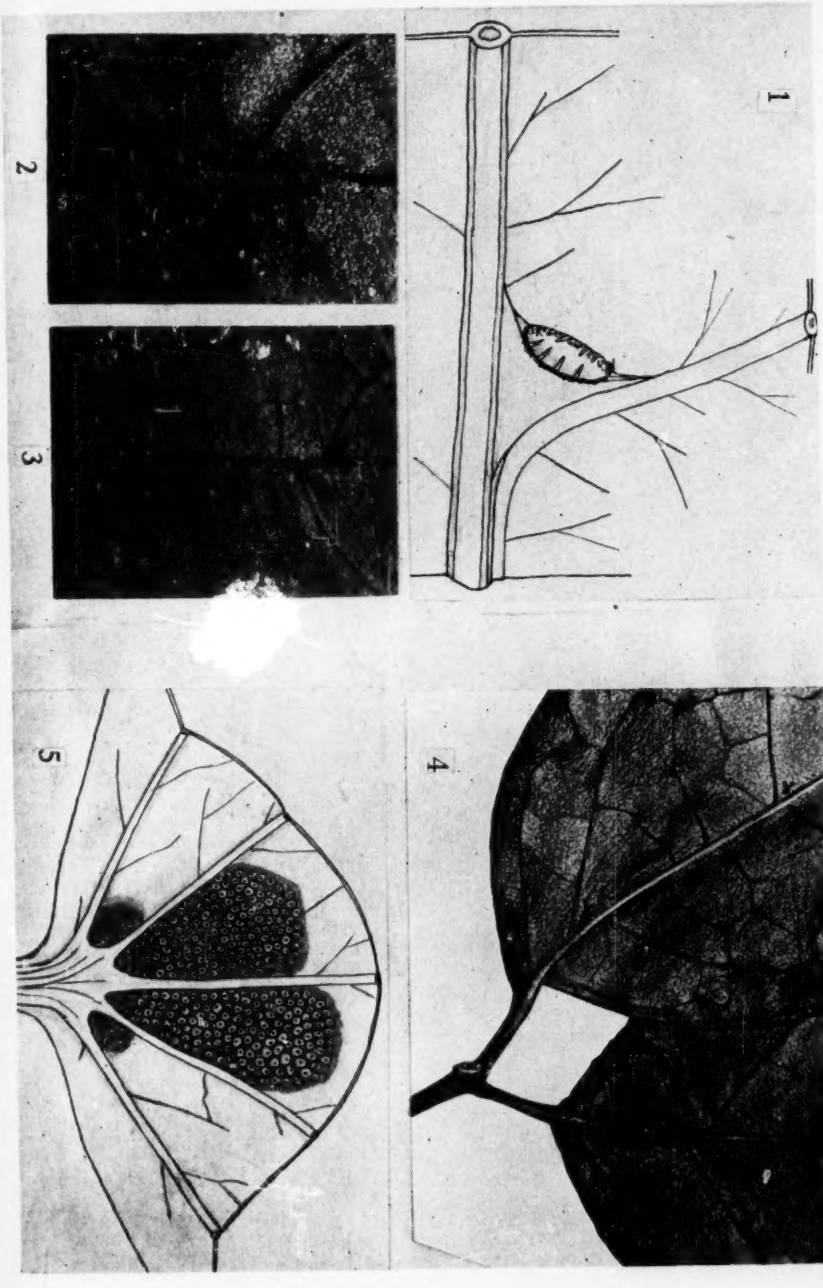
Fig. 1. Portion of the lower leaflet surface of *Ceratophytum tobagense* (Urb.) Sprague & Sandw., showing a domatium or modified cavity in the axil of a lateral nerve.

Fig. 2. Domatia in the axils of the lateral nerves on the lower surface of a leaflet of *Arrabidaea obliqua* (HBK.) Bur.; × ¾.

Fig. 3. Evidence of domatia as seen on the upper surface of a leaflet of *Arrabidaea obliqua*. Scattered glands may be observed in close proximity to the mid-vein; × ¾.

Fig. 4. Glandular fields in the axils of the lateral veins on the lower leaflet surface of *Anemopaegma Chamberlaynii* (Sims) Bur. & K. Schum. The glandular scaly or lepidote condition of the lower surface may be clearly seen.

Fig. 5. Portion of the lower leaflet surface of *Cydista heterophylla* Seib. showing glandular fields in the axils of the main lateral veins.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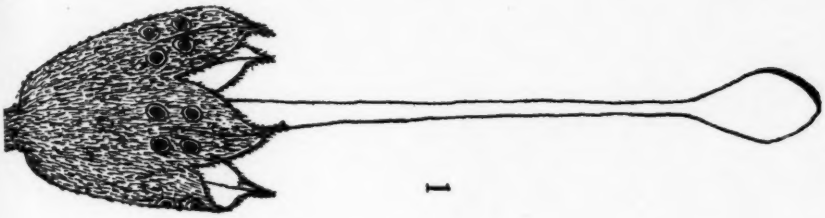
Explanation of Plate

PLATE 5

Fig. 1. Position of the glands on the calyx of *Adenocalymma bracteatum* (Cham.) DC.; × 4.

Fig. 2. Corolla glands at the base of the lobes of *Memora Klugii* Standl.; × 4.



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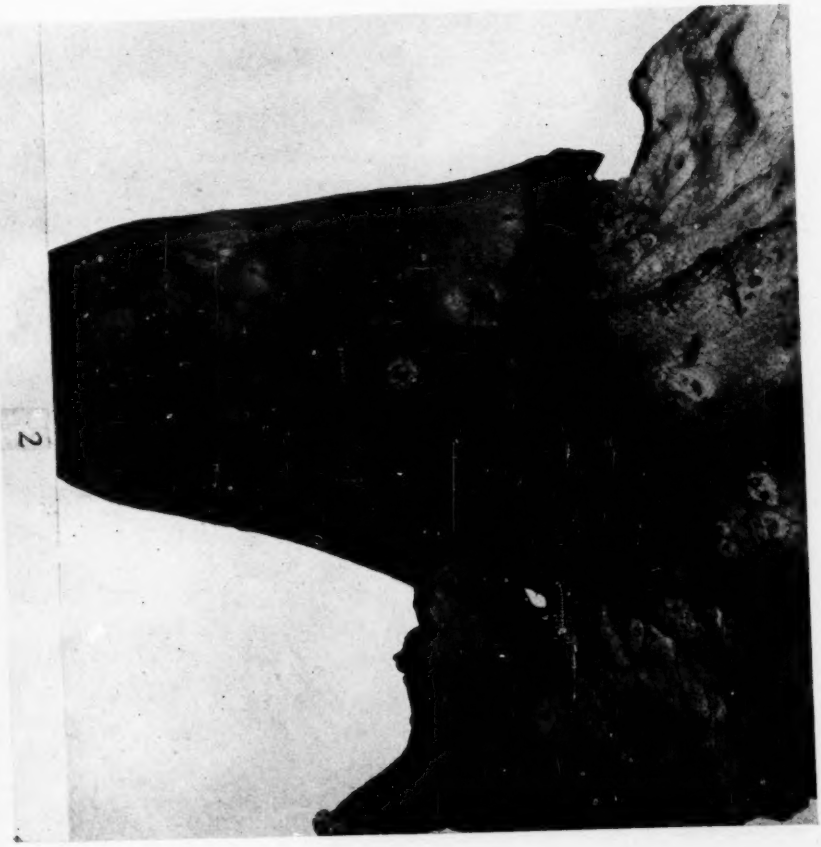

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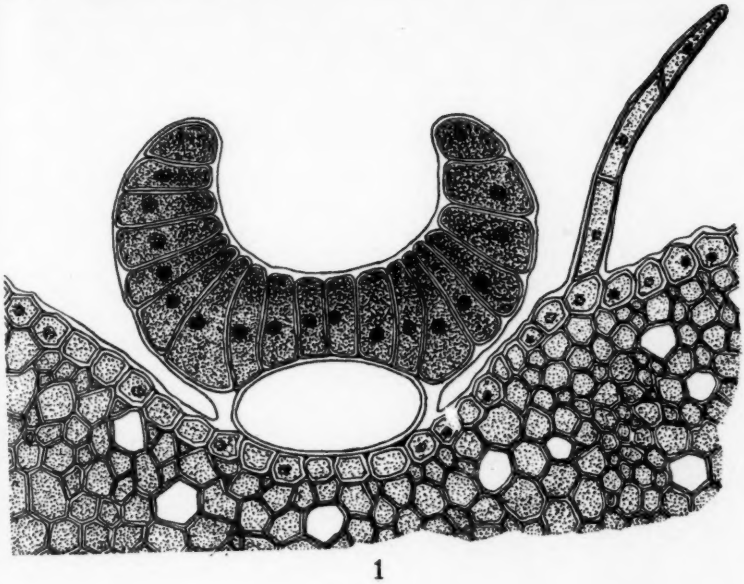
EXPLANATION OF PLATE

PLATE 6

Fig. 1. *Lundia corymbifera* (Vahl) Sandw. Cross-section through the node on a young stem showing detail of an interpetiolar gland.

Fig. 2. *Anemopaegma Chamberlaynii* (Sims) Bur. & K. Schum. Section through the ovary showing detail of the glandular scales on the outer surface.

Fig. 3. Section through the lower leaflet surface of *Anemopaegma Chamberlaynii*, showing detail of a somewhat immersed glandular scale.



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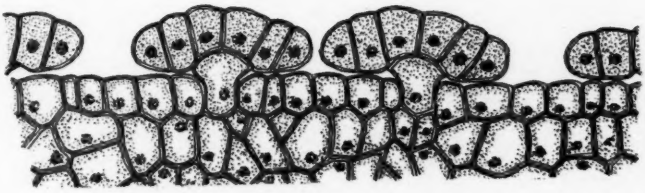

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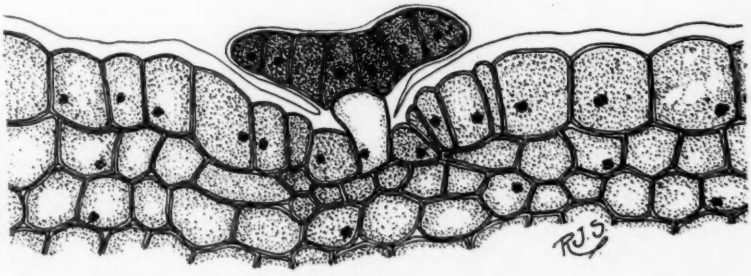


3

SEIBERT—GLANDS IN THE BIGNONIACEAE

Explanation of Plate

PLATE 7

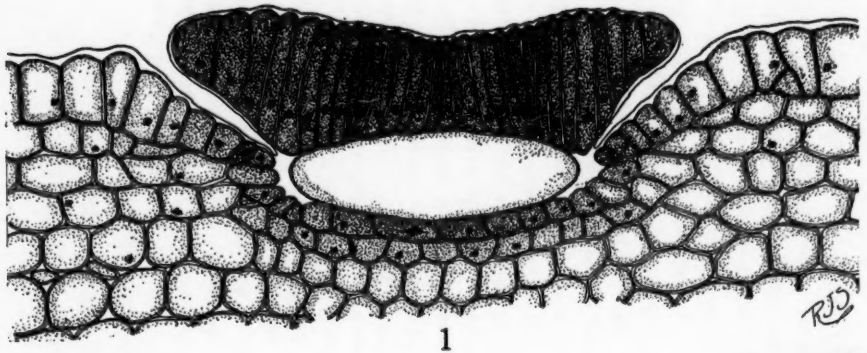
Fig. 1. *Anemopaegma Chamberlaynii* (Sims) Bur. & K. Schum. Section through a glandular field in the axil of a lateral leaflet vein showing detail of one of the glands.

Fig. 2. *Callichlamys latifolia* (L. C. Rich.) K. Schum. Section through the inflated calyx showing detail of a large immersed gland.

Fig. 3. *Jacaranda mimosifolia* D. Don. Staminodium showing relative size, density, distribution, and length of the capitate glandular hairs; × 3.

Fig. 4. Detail of a capitate glandular hair from the staminodium of *Jacaranda mimosifolia*; × 30.

Fig. 5. Looking down on the upper surface of a capitate glandular hair from the staminodium of *Jacaranda mimosifolia*; × 25.



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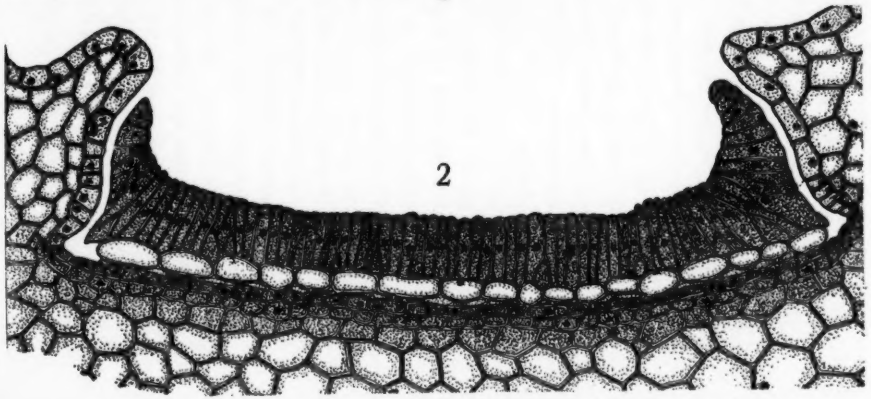

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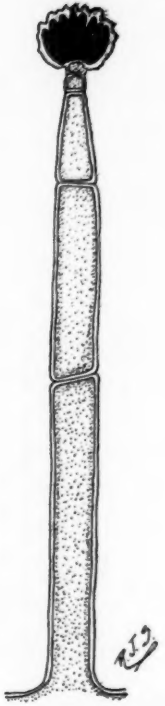

4

GYNANDROPSIS, CLEOME, AND PODANDROGYNE

ROBERT E. WOODSON, JR.

The genus *Gynandropsis* was established by de Candolle[1] in 1824 and supplied with nine species indigenous to the tropics and subtropics of both hemispheres, largely segregates from the Linnaean *Cleome*. The separation of the two genera was based upon the "torus": that of the latter "*subhemisphaericus*," and that of the former "*elongatus*." The separation was accepted generally and promptly, although with various phrasing by different authors ("Androphor kurz oder fehlend" *vs.* "Androphor entwickelt, deutlich"—Pax & Hoffman; "Stamens free" *vs.* "Stamens attached to the gynophore"—Fawcett & Rendle).

The flowers of *Cleome* and of *Gynandropsis*, as originally segregated, normally are hermaphrodite; hence the publication by Bentham[2] in 1845 of two monoecious species from the northern Andes, *G. coccinea* and *G. densiflora*, was of particular interest. Bentham described the inflorescences of his species as bearing staminate flowers toward the tip and pistillate flowers toward the base. Not until later was it appreciated that two of de Candolle's original species also possessed this character, namely *G. brachycarpa* and *G. hispidula*, also of the northern Andes.

In 1854, Turczaninov[3], apparently unaware of Bentham's publication, proposed several additional South American species of *Gynandropsis*, some of them synonymous with those of the earlier author. This article is particularly interesting, however, in the implied (but unfortunately not formally proposed) segregation of the hermaphrodite species into the section *Eugynandropsis*, and those with monoecious flowers into the sections *Hymenadenia* and *Gyradenia*. Although recognizing *Gynandropsis* merely as a section of *Cleome*, Triana & Planchon[4] also divided the Colombian species into two unnamed subsections having the flowers hermaphrodite or monoecious, respectively. Also noteworthy in this latter treatment is the description of *Cleome (Gynandropsis) decipiens*, a peculiar plant bearing large, simple leaves in contrast to the palmately compound leaves of other species of *Gynandropsis*. The discernment of these three early authors puts to shame their successors who ignored them for over three-quarters of a century.

In 1891, Pax[5] discarded *Gynandropsis* in favor of the earlier *Pedicellaria* Schrank[6], but in 1930 the former name was conserved by the Cambridge Congress[7], and the lectotype proposed as *G. pentaphylla* (L.) DC., a hermaphrodite species.

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[1] DC. Prodr. 1:237. 1824.
[2] Benth. Pl. Hartw. 160. 1845.
[3] Turcz. in Bull. Soc. Nat. Moscou 27^2:313. 1854.
[4] Tr. & Pl. Prodr. Fl. Novo Gran. 70. 1862.
[5] Pax, in Engl. & Prantl, Nat. Pflanzenfam. ed. 1. 3^2:223. 1891.
[6] Schrank, in Roemer & Usteri, Mag. 3:10. 1790.
[7] Int. Rules, ed. 3. 97. 1935.

Issued June 22, 1948.

In 1930, Ducke[8] published the genus *Podandrogyne* from eastern Peru. Ducke appreciated the relationship of his genus to the monoecious species of *Gynandropsis* but, paradoxically, was handicapped, on the one hand, by the excellence of his study collection and, on the other, by ignorance of the fruiting habit of the species of monoecious *Gynandropsis*. Hence, the primary characters of his *Podandrogyne* were fruiting characters: "*Cleomoideis . . . differt replo nullo valvis post dehiscentiam irregulariter contortis.*" Ducke's illustration of *P. glabra*, the monotype, is excellent in detail of the simple-leaved (cf. *Cleome decipiens* Tr. & Pl.) species with monoecious flowers in an ebracteate raceme, with the peculiarly contorted replum (sic!) of the irregularly dehiscent silique. Also drawn with careful detail is a character apparently unappreciated by the author: the conspicuous membranaceous, funicular aril of the seed!

During the preparation of my account of Capparidaceae for the 'Flora of Panama,' compiled by Dr. Schery and myself[9], I have had the opportunity to examine numerous specimens of *Gynandropsis* from South America as well as from Panama, and have found it easy to demonstrate that all monoecious species of *Gynandropsis*, whether bearing simple or palmately compound leaves, produce fruit with the peculiar silique dehiscence and arillate seeds so well illustrated by Dr. Ducke. The fruit, however, is not actually without a replum, as may easily be observed from any specimen. But, except possibly in the case of *G. brachycarpa* DC., the pericarp appears to rupture irregularly without the customary abscission of the two valves, and the replum abjuncts at the apex, later undergoing the characteristic contortion. These features surely must have been displayed by the rich South American collections at Berlin, and it is difficult to understand how Pax & Hoffman[10] could see fit to erect a new subfamily, Podandrogynoideae, for the monotypic *Podandrogyne*, while leaving the numerous monoecious species within *Gynandropsis* of the Cleomoideae.

The Capparidaceae are a fascinating family which has not been studied effectively in its American representation since 1865[11]. Were I to undertake such a study, I am sure that I should return the hermaphrodite species of *Gynandropsis* to *Cleome*, since it would be an easy task to reveal the unreliable nature of the "torus" character, unsupported as it is by any other. The problem is one of considerable magnitude, however, and one which I must leave to another. Nevertheless, I do feel competent at the present time to append to this discussion a brief synopsis emending the genus *Podandrogyne* to include all monoecious species of *Gynandropsis*.

My study collection consists chiefly of specimens deposited in the herbaria of the Missouri Botanical Garden and the Chicago Natural History Museum, augmented by certain material from the U. S. National Herbarium and the Royal

[8] Ducke, in Archiv. Jard. Bot. Rio Jan. 5:115. *pl. 7.* 1930.
[9] Woodson & Schery, in Ann. Missouri Bot. Gard. 35:75. 1948.
[10] Pax & Hoffm. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 17b:208. 1936.
[11] Eichl. in Mart. Fl. Bras. 13^1:238. 1865.

Botanic Gardens, Kew. Types from continental European herbaria are represented by photographs prepared by J. Francis Macbride through the Rockefeller Fund.

PODANDROGYNE Ducke, emend.

PODANDROGYNE Ducke, in Archiv. Jard. Bot. Rio Jan. 5:115. 1930.

Gynandropsis DC. Prodr. 1:237. 1824, in part.

Erect or ascending, suffrutescent or suffruticose herbs; leaves alternate, simple or palmately compound, exstipulate; inflorescence racemose or corymbose, terminal, several- to many-flowered, bracteate or ebracteate; flowers monoecious, rarely andromonoecious or dioecious through abortion, the lower flowers pistillate, the upper staminate; calyx more or less deeply 4-parted, persistent or deciduous, sometimes more or less petalaceous; petals 4, more or less unequal, usually unguiculate; disc usually manifest, symmetrical or eccentric; fertile stamens 6, inserted on a short or moderately elongate, concentric or eccentric gynophore, the filaments somewhat unequal and declinate, the anthers dorsifixed near the base, accompanied by an abortive pistillode; fertile ovary borne upon a manifest, concentric or eccentric gynophore, the stigma capitate, sessile or stipitate, the ovules numerous, the accompanying staminodia greatly reduced, sagittate, borne upon a manifest androgynophore; fruit a dry, terete or somewhat compressed silique, usually dehiscing irregularly, the replum finally separating at the tip (except in *P. brachycarpa?*) and irregularly contorted; seeds cochleate-reniform, with a conspicuous lamellate, funicular aril.

Type species: PODANDROGYNE GLABRA Ducke, loc. cit. 1930.

a. Androgynophores included, concentric, the disc inconspicuous and essentially radial, not enlarged and conspicuous in fruit.
  b. Leaves palmately compound, usually 3- to 7-foliolate; calyx lobes cleft nearly to the receptacle; Costa Rica and Panama (to Peru?).... 1. *P. chiriquensis*
  bb. Leaves simple; calyx campanulate, the lobes cleft about half or less to the receptacle; Colombia.... 2. *P. decipiens*
aa. Androgynophores exserted, conspicuously eccentric through the unilateral development of a thick disc which is enlarged and conspicuous in fruit.
  b. Leaves palmately compound, usually 3- to 7-foliolate, or the uppermost or lowermost occasionally simple.
    c. Fruits linear-oblongoid, much longer than the androgynophore.
      d. Inflorescence corymbose, greatly contracted, not secund, erect; Colombia and Ecuador.... 3. *P. coccinea*
      dd. Inflorescence racemose, relatively elongate, secund, somewhat cernuous; Venezuela.... 4. *P. cernua*
    cc. Fruits broadly oblongoid to ovoid, about as long as the androgynophore or somewhat shorter.
      d. Plants densely pubescent; leaflets 5–9; lowermost flowers frequently perfect; inflorescence frequently with more or less persistent, foliaceous bracts; Colombia to Bolivia.... 5. *P. brachycarpa*
      dd. Plants essentially glabrous; leaflets 3, or the lowermost or uppermost sometimes simple; flowers apparently always monoecious; inflorescence ebracteate; Colombia and Ecuador.... 6. *P. gracilis*
  bb. Leaves simple.
    c. Inflorescence relatively elongate, secund, somewhat cernuous.
      d. Calyx lobes ovate to ovate-lanceolate, acuminate, pale green suffused with pink; fruits clavate-oblongoid, about as long as

the androgynophore or somewhat shorter; Colombia and Venezuela ..... 7. *P. macrophylla*

dd. Calyx lobes ovate-subreniform, obtuse, deep purple; fruits linear-oblongoid, about twice as long as the androgynophore; Colombia ..... 8. *P. polychroma*

cc. Inflorescence congested, not secund, erect; Colombia to Peru and adjacent Brazil ..... 9. *P. glabra*

1. PODANDROGYNE CHIRIQUENSIS (Standl.) Woodson, in Ann. Missouri Bot. Gard. 35:85. 1948.

Gynandropsis chiriquensis Standl. in Jour. Wash. Acad. 17:252. 1927.
Gynandropsis pulcherrima Standl. loc. cit. 253. 1927.

COSTA RICA: *Standley & Valerio 44560; Dodge & Thomas 5628; A. Smith H. 481; A. Smith P.C. 361; Skutch 3627.* PANAMA: *White & White 50; P. White 168; Seibert 138, 334; Woodson, Allen & Seibert 859; Woodson & Schery 539; Davidson 180; Allen 1650, 219, 2730, 4780, 4956; Hunter & Allen 552.*

Standley's primary distinction between *G. chiriquensis* and *G. pulcherrima* is based upon number of leaflets: five in the former and three in the latter. The Costa Rican specimens enumerated above all have three leaflets, and one may judge that the eleven additional Costa Rican specimens enumerated by Standley are constant to that number. Amongst the Panamanian specimens before me, three from the province of Chiriquí bear 3-foliolate leaves, and seven bear leaves which are 5- to 7-foliolate. Farther east, in the province of Coclé, three plants again bear 3-foliolate leaves. Since I have been able to discover no additional character to separate *G. chiriquensis* and *G. pulcherrima*, I am unwilling to maintain the two species separately, although they might be regarded as varieties with rather poor geographical differentiation.

Whether *P. chiriquensis* extends into northern South America is a subject for conjecture because of our meagre representation of the genus. Two specimens before me, however, will fall to that species in the key which I have prepared, although they differ from the Central American population in certain respects; both are 3-foliolate: *Pennell 14073*, from the department of Cusco, Peru, is the type specimen of *Gynandropsis Herrerae* Macbr. (in Field Mus. Publ. Bot. 4:168. 1929); at first glance strongly recalling Costa Rican *G. pulcherrima*, this plant differs in the slightly more coherent calyx lobes, thus recalling *Podandrogyne coccinea*. *Cuatrecasas 11497*, from Comisaría del Putumayo, Colombia, also will key to *P. chiriquensis*, the calyx being rather typical of the latter species, but the mature fruits are scarcely half as long. It may well be that these two sheets represent two distinct species, but I am inclined to consider hybridization of *P. chiriquensis* with such typically South American species as *P. coccinea* and *P. gracilis* as equally possible.

2. PODANDROGYNE **decipiens** (Tr. & Pl.) Woodson, comb. nov.

Cleome decipiens Tr. & Pl. Prodr. Fl. Novo Gran. 75. 1862.
Gynandropsis decipiens (Tr. & Pl.) Pax & Hoffm. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 17b:218. 1936.

COLOMBIA: *Cuatrecasas 13685.*

This specimen, collected by Dr. Cuatrecasas on the Cordillera Occidental, Depto. del Valle, at 300 m. alt., is of particular interest since it apparently represents the first collection of this species since the type. I have not been able to examine the type, collected at Quindio, and it is not represented in the Macbride collection of type photographs; but our specimen agrees so thoroughly with Triana and Planchon's description that there can be little doubt of its identity. Our specimen in the herbarium of the Missouri Botanical Garden is represented by two sheets bearing identical data, and is of interest from the standpoint of leaf variation. In one sheet, the leaves are broadly ovate and cordate, while in the other they are less broadly ovate and rounded at the base.

3. PODANDROGYNE **coccinea** (Benth.) Woodson, comb. nov.

Gynandropsis coccinea Benth. Pl. Hartw. 160. 1845.
Gynandropsis aurantiaca Turcz. in Bull. Soc. Nat. Mosc. 27^2:315. 1854.

COLOMBIA: *Hartweg 888; Linden 814; Funck & Schlim 1648* (photo). ECUADOR: *Mexia 8443, 8444; Steyermark 54230.*

This species is the Colombian and Ecuadorian counterpart of the Central American *P. chiriquensis*, from which, beside the more important key characters, it may be distinguished by the greater connation of the calyx lobes.

4. PODANDROGYNE **cernua** Woodson, spec. nov.

Herba ca. 1.5 m. longa aut fortasse basi frutescens omnino glabra. Folia longe petiolata lamina 3-foliolata foliolis brevissime petiolulatis ellipticis subcaudato-acuminatis basi latiuscule acutis 9–13 cm. longis 3–5 cm. latis membranaceis petiolo ca. 7–10 cm. longo. Inflorescentia terminalis racemiformis sat elongata secunda multiflora ebracteata; pedicellis usque 2.5 cm. longis; floribus inferioribus femineis superioribus masculis. Florum masculorum calyx campanulatus laciniis ca. tertia parte connatis acutis ca. 5 mm. longus glaber ruber apice purpureus; petala oblongo-spatulata ca. 1 cm. longa salmonea; androphorium eccentricum basi disco carnoso unilaterali cinctum ca. 1 cm. longum; antherae 6 ca. 8 mm. longae filamentis subaequilongis. Flores feminei desunt. Siliquae immaturae lineares glabrae stigmate sessili stipitatae basi glandula peristente instructae.

VENEZUELA: Mérida: between Los Corales and Las Cuadras, alt. 1490–3210 m., March 25, 1944, *J. A. Steyermark 55772* (Herb. Chicago Nat. Hist. Mus., TYPE).

It is rather remarkable that the two Venezuelan species of *Podandrogyne*, this and *P. macrophylla*, both are characterized by secund inflorescences. From the latter species, *P. cernua* differs not only in its palmately compound leaves, but in the larger flowers and linear, shortly stipitate fruits.

5. PODANDROGYNE **brachycarpa** (DC.) Woodson, comb. nov.

Gynandropsis brachycarpa DC. Prodr. 1:238. 1824.
Cleome brachycarpa Vahl, ex DC. loc. cit. 1824, nom. nud. in synon.
Gynandropsis hispidula DC. loc. cit. 1824.

Cleome hirsuta R. & P. ex DC. loc. cit. 1824, nom. nud. in synon.
Gynandropsis densiflora Benth. Pl. Hartw. 160. 1845.
Gynandropsis phoenicea Turcz. in Bull. Soc. Nat. Mosc. 27²:316. 1854.
Gynandropsis adenocarpa Turcz. loc. cit. 1854.
Cleome puberula Tr. & Pl. Prodr. Fl. Novo Gran. 71. 1862.
Cleome densiflora Benth. ex Tr. & Pl. loc. cit. 72. 1862.
Cleome densiflora β pallens Pl. & Lind. ex Tr. & Pl. loc. cit. 1862.
Cleome Macrothyrsus Tr. & Pl. loc. cit. 1862.
Cleome lateralis Tr. & Pl. loc. cit. 73. 1862.
Cleome brachycarpa Vahl, ex Tr. & Pl. loc. cit. 1862.
Pedicellaria Lehmannii Hieron. in Engl. Bot. Jahrb. 20, Beibl. 49:20. 1895.
Pedicellaria Ulei Gilg, in Engl. Bot. Jahrb. 40:421. 1908, nom. nud.
Gynandropsis Ulei Briq. in Ann. Cons. & Jard. Bot. Genève 17:385. 1914.
Gynandropsis Mathewsii Briq. loc. cit. 387. 1914.
Gynandropsis Jamesonii Briq. loc. cit. 388. 1914.
Gynandropsis puberula (Tr. & Pl.) Macbr. in Field Mus. Publ. Bot. 11:22. 1931.
Gynandropsis hirsuta Moldenke, in Phytologia 1:5. 1933.
Gynandropsis lateralis (Tr. & Pl.) Pax & Hoffm. loc. cit. 1936.
Gynandropsis macrothyrsus (Tr. & Pl.) Pax & Hoffm. loc. cit. 1936.

This rather formidable synonymy has accumulated primarily because of the variability of texture and quantity of indument of the collected specimens, but also because of the bracteate inflorescence of certain of them and the ebracteate appearance of others. The species evidently is a rather common one from Colombia to Bolivia, and has been collected repeatedly. Although such questions are solved better through study of living plants, I have come to the conclusion through study of the exsiccatae enumerated below that *P. brachycarpa* is characterized by inflorescence bracts which are rather irregularly caducous, the latter propensity accounting for the seeming biotic variability. The bracts also, as is normal, decrease in size from base to apex of the inflorescence, so that inflorescences in a late state of development, in which the lower bracts have been lost, appear to be completely ebracteate.

A more important feature of the species, which apparently has been overlooked by most students, is the propensity for the lowermost flowers of the inflorescence to be hermaphrodite, and not pistillate only as in the other species. This character, together with the bracts, might suggest this species as being possibly the most primitive of the genus, at least from a structural standpoint.

COLOMBIA: *Haught 1953; Dryander 2081; Arbelaez & Cuatrecasas 6181; Lehmann 7437* (photo); *Triana s. n.* (photo); *Triana s. n.* (photo); *Triana s. n.* (photo); *Funck & Schlim 1407* (photo). ECUADOR: *Steyermark 54295; Steyermark 54867; Skutch 4542; Eggers 14907; Penland & Summers 111; Jameson 461* (photo). PERU: *Vargas 524; Macbride 4213; Schunke 266; Poeppig 1530; Weberbauer 6653; Ule 6430* (photo); *Mathews 193* (photo); *Pavon s. n.* (photo). BOLIVIA: *Buchtien 2219; Cardenas 707.*

6. PODANDROGYNE **gracilis** (Tr. & Pl.) Woodson, comb. nov.

Cleome gracilis Tr. & Pl. Prodr. Fl. Novo Gran. 74. 1862.
Cleome gracilis β turgescens Tr. & Pl. loc. cit. 1862.
Cleome porphyrantha Tr. & Pl. loc. cit. 71. 1862.

Gynandropsis gracilis (Tr. & Pl.) Macbr. in Field Mus. Publ. Bot. 11:22. 1931.
Gynandropsis porphyrantha (Tr. & Pl.) Pax & Hoffm. in Engl. & Prantl, Nat. Pflanzenfam. 17b:218. 1936.

COLOMBIA: *Cuatrecasas 8706; Goudot s. n.; Triana s. n.* (photo). ECUADOR: *Haught 2884; Steyermark 52853; Sodiro 68* (photo).

It is impossible for me to effect an absolute separation of this species and *P. brachycarpa*. Typically, as the preceding key suggests, the population which I call *P. brachycarpa* would appear amply distinct from the more northern *P. gracilis*. Amongst the specimens enumerated above, however, there is obvious intergradation, particularly with respect to indument, which might be construed as evidence of interspecific introgression through hybridization.

7. PODANDROGYNE **macrophylla** (Turcz.) Woodson, comb. nov.

Gynandropsis macrophylla Turcz. in Bull. Soc. Nat. Mosc. 27^2:314. 1854.

COLOMBIA: *Funck & Schlim 1210* (photo). VENEZUELA: *Steyermark 55821.*

Discussed previously with regard to *P. cernua.*

8. PODANDROGYNE **polychroma** Woodson, spec. nov.

Suffrutex erectus ca. 2 m. longus omnino glaber. Folia sat breviter petiolata lamina simplice late elliptica breviter acuminata basi late acuta ca. 20 cm. longa 10–11 cm. lata membranacea petiolo ca. 2.5 cm. longo. Inflorescentia terminalis racemiformis sat elongata secunda (?) multiflora ebracteata; floribus inferioribus femineis superioribus masculis; pedicellis usque 1 cm. longis. Florum masculorum sepala libera ovato-subreniformia obtusa ca. 5 mm. longa 7 mm. lata purpurea petala oblongo-obovata ca. 8 mm. longa rosea; androphorium eccentricum basi disco carnoso unilaterali cinctum ca. 1 cm. longum; antherae 6 ca. 8 mm. longae filamentis subaequilongis. Flores feminei desunt. Siliquae fusiformes glabrae ca. 10 cm. longae androgynophorio ca. 4 cm. longo basi glandula persistente instructo.

COLOMBIA: El Valle: Cordillera Occidental; vertiente occidental; Hoya del río Sanquininí, lado izquierdo, La Laguna, bosques, 1,250–1,400 m. alt., Dec. 10–20, 1943, *J. Cuatrecasas 15578* (Herb. Missouri Bot. Gard., TYPE).

This species is utterly unlike any other known to me in the shape and color of the sepals, and particularly in the very large and conspicuous gland at the base of the fruiting androgynophores. Unfortunately, the one inflorescence is well past prime; consequently its description as secund must await verification.

9. PODANDROGYNE GLABRA Ducke, Archiv. Jard. Bot. Rio Jan. 5:115. *pl. 7, fig. 9.* 1930.

Gynandropsis orba Macbr. in Candollea 5:359. 1934.
Podandrogyne pubescens Asplund, in Sv. Bot. Tidskr. 30:266. *fig. 1.* 1936.
Podandrogyne orba Macbr. in Field Mus. Publ. Bot. 13^2:988. 1938.

COLOMBIA: *von Sneidern 1684.* ECUADOR: *Steyermark 52654; Sodiro 67* (photo). PERU: *Weberbauer 6760; Killip & Smith 26125; Killip & Smith 29594; Killip & Smith 29480.* BRAZIL: *Ducke 19701* (photo).

Podandrogyne pubescens differs from typical *P. glabra* only in its copious indument, as far as I am able to judge. But in several of the specimens enumerated above, which superficially appear glabrous, traces of pubescence may be found, particularly upon the petioles and peduncles. *P. pubescens* might possibly be interpreted as a variety of *P. glabra*, but I am not willing to maintain it as a species at the present time.

Explanation of Plate

Plate 8

Figs. 1–5. *Podandrogyne chiriquensis:* 1, habit; 2, seed; 3, dehisced fruit; 4, staminate flower; 5, pistillate flower.

Fig. 6. *Podandrogyne coccinea:* staminate flower.

WOODSON—GYNANDROPSIS, CLEOME, AND PODANDROGYNE

MAIZE IN THE GREAT HERBALS[1]

JOHN J. FINAN[2]

INTRODUCTION

Maize is a plant of such overwhelming importance to the people who have grown it that its history is of special significance. There are so many kinds of maize, however, and it has been grown by so many people and for so long that its history is complex and difficult to piece together. The literature regarding it is scattered and fragmentary and mostly without illustrations. For one period, though, the record is fairly well documented. Beginning about a half-century after the discovery of America and extending through the seventeenth century, the plant is discussed in detail in the great European herbals. A careful examination and comparison of the material in these plant books with information on maize in the early chronicles of the New World will give us a reasonably accurate picture of what kinds of maize were current in Europe for the first few centuries after its introduction there. Moreover, as this study contributes to a more accurate understanding of maize, it should in numerous secondary ways illuminate the stories of the peoples who were growing it.

Most of the herbals are in Latin but all the major vernacular languages of Western Europe are represented. Discussions of plants in the herbals generally follow an outline formulated by the ancients. Separate sections in each discussion are devoted to various names for the plant, a description of it and its uses, medicinal properties, and place of origin. In the examination of the herbals, the information about the plant was abstracted systematically in tabular form on large ruled cards to allow for rapid and exact comparison of variations in different editions and among different herbalists. The great herbals are copiously illustrated with woodcuts, which present realistic pictures of the various types of maize seen by the herbalists.

The collection of herbals in the Missouri Botanical Garden Library, which includes almost every edition of every major herbal of the sixteenth and seventeenth centuries, was almost exclusively the source for the study of these plant books. In addition, the account in one of the first herbals to discuss maize, that of Bock (1539), was used in the form of a photostat copy supplied by the library of the Arnold Arboretum of Harvard University.

[1]This work, done under a grant from Pioneer Hi-Bred Corn Co., Des Moines, Iowa, was originally presented as a master's thesis at Washington University. Faculty members of four departments of the University assisted the author: Dr. Edgar Anderson, of the School of Botany, who directed the project and helped in analyzing the biological significance of the material; Drs. William Bull, Herbert Dieckmann, Sherman Eoff, Bernard Weinberg, and the late Bateman Edwards, of the Department of Romance Languages, and Dr. Norman DeWitt, of the Department of Classics, all of whom assisted with textual problems and gave valuable suggestions on organizing the paper; and Dr. Horst Janson, of the Department of Art and Archaeology, who assisted with the examination of the woodcuts.

[2]Formerly Pioneer Hi-Bred Corn Co. Fellow in Washington University.

MAIZE IN POST-CONQUEST HISPANIC AMERICA

The significance of maize as a major crop—a staple food among the natives of the New World—led European explorers there to write about the plant in their reports. They make some mention of what it looked like and go into great detail about its uses and the customs and ceremonies associated with it. These reports are scattered, however, and only a brief summary of some of the major discussions of maize is presented here.

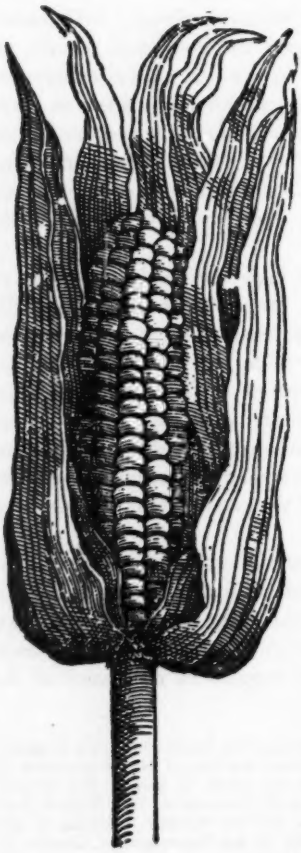

Fig. 1. The first illustration of maize published in Europe. From a seventeenth century translation of Oviedo's *Historia natural y general*, and reported to have been in the 1535 edition of his work.

Beginning with the first reports of Columbus, there are countless references to maize in the literature of exploration.[3] Almost all the major explorers mention the plant, but the first visitor to the New World to discuss maize in detail was a Spanish inspector of mines, Gonzalo Fernández de Oviedo y Valdés, who was sent to America in 1513[4]. The history of the Indies, which he compiled and published in 1526 and 1535,[5] contains an entire chapter on maize. And throughout his multi-volumed work, he gives a vivid picture of the place of maize in the life of the natives.

A contemporary of Oviedo, Francisco López de Gómara, who also visited the New World, and who, besides, received a great deal of material from Cortés,[6] includes detailed

[3]On his third voyage Columbus describes maize as "a seed which produces a spike like a cob, which I brought there, and now there is much of it in Castile;" —quoted by Salvador de Madariaga, *Vida del muy magnifico señor don Cristobal Colón*. Editorial in *Sudamericana*, p. 455. 1940.

The famous chronicler of Columbus' Travels, Peter Martyr, also reports of the plant as early as 1511: "This millet [maize] is a little more than a palm in length, ending in a point, and is about the thickness of the upper part of a man's arm. The grains are about the form and size of peas. While they are growing, they are white, but become black when ripe. When ground they are whiter than snow. This kind of grain is called *Maiz*."—*De Orbe Novo, The Eight Decades of Peter Martyr d'Anghera*. 1:64. Trans. from the Latin with notes and introd. by Francis Augustus MacNutt. New York and London, 1912.

[4]Miall, L. C. *The early naturalists*, p. 60.

[5]*La historia natural y general de las Indias yslas y tierra firme del mar oceano*. . . Sevilla.

[6]López de Gómara, Francisco. *Encyc. Brit.* 14:387. 14th ed. 1929.

accounts of maize in his *General History of the Indies* (1552). Another natural historian of the New World, Joseph de Acosta, who visited Peru in 1570 and Mexico in 1583,[7] published references to the maize of these regions in 1590.[8] In addition, there was a vast amount of material, not available to the Renaissance herbalists and only now being published, which contains a great deal of information on the plant. This has been obtained from *relaciones*, answers to a series of questionnaires sent out by the Spanish government, the first in 1577 and the second a quarter of a century later. There are items in both questionnaires inquiring about the grains of each region. A portion of these reports has been assembled and published in two collections.[9]

Piecing together the picture of what maize was like in the New World during the Conquest is difficult because of the frequently sketchy descriptions of the explorers. They were describing it to a world which had never seen it, and their descriptions are not precise, but general, and in terms which their readers could understand.

Oviedo used familiar comparisons in giving a picture of maize. The breadth of the maize stalk, he says, was either the size of one's thumb or the thickness of a calvaryman's lance, depending on the fertility of the soil. Its height he estimated as much higher than that of a man, and its leaves look like those of the common cane of Spain but "much longer and narrower, more flexible and greener." With more detail, he adds:[10]

> Each stalk produces at least one ear, and some two or three. There are about two hundred or more grains, depending on the size of the ear. Each ear is wrapped in three or four rather coarse leaves or coverings [husks], attached close to the grains, one on top of the other, and of the same texture as the leaves of the stalk.

Oviedo, speculating about the origin of the plant, suggests that it is the same as a plant described by the first-century Italian natural historian, Pliny. Indirectly he gives us more details about the corn plants he saw in the New World, as well as about some he saw in Europe:[11]

> As I am fond of reading Pliny, I shall repeat here what he says of the millet of India. I think it is the same as what we call "mahiz" in our Indies. Pliny says: "Ten years ago there came a millet from India which is black and has a large kernel. The stalk, like reeds, grows seven feet high . . . . It is the most fertile of all grains. One grain yields three *sextarii*. It should be sown in damp places." From this description . . . . [of Pliny] . . . . I would consider it to be maize because even though he remarks that it is black, maize in the New World

[7] Miall, *op. cit.*, p. 65.

[8] An old English translation was the oldest found available: Acosta, Ioseph, *The Naturall and morall historie of the East and West Indies*. Trans. by E. Grimestone. London, 1604.

[9] *Papeles de Nueva España, segunda serie, geografía y estadística*. Ed. by Francisco del Paso y Troncoso. 7 vols. Madrid, 1905; *Relaciones geográficas de Indias*. Ed. by Marcos Jiménez de la Espada. 4 vols. Madrid, 1881–1897.

[10] *Op. cit., Lib. 7, Cap. 1, Fol. 72.* Translation of this and other quotations from original texts made by author unless otherwise stated. See original passages in Appendix II.

[11] *Historia general y natural de las Indias* . . . . publ. by Real Acad. Hist. 1:268. Madrid, 1851.

Von der kreüter underscheyd

Von dem Welschen Korn/cap.xxv.

Unser Germania würt bald felix Arabia heyssen/ dieweil wir so vil frembder gewächs von tag zů tag aus frembden landen inn unsern grund gewenen/ under welchen das groß Welsch korn nit das geringst ist/ on zweiffel erstmals von kauffleütten aus warmen feysten landen zů uns gefürt worden/ dann es will gůtten grund haben/ unnd mag zů mal keyn frost oder reiffen dulden/ gleich wie die frembden Bonen. Des grossen frembden Korns/ haben wir dreier oder viererley farben/ etlichs rot/ etlichs braun/ etlichs geel/ unnd etlichs gantz weiß/ yedes korn ist eyner feld Fäselen groß/ würt imm Apellen inn eyn gůt ertrich/ da die Son stets hin mag/ gepflantzet. Stoßt erstmals auch nur eyn graß keymen/ breyter dann die Gersten/ beinahe wie Hirsen. Nach dem ersten folgen die andern ye lenger unnd breyter/ grösser dann des rors. Die stengel wachsen hoch unnd dick/ unnd als die winter Rosen/ gewinnen auch jre knöpff. Die öberste ungeschlossene Jube oder ähern/ thůn sich weitter uff/ dem Ror gleich/ blüen wie ander Korn/ etliche braun/ etlichs weiß/ etlichs geel/ nach dem die frucht ist. Das gröst unnd verborgen geheymnüs der natur an disem gewächs ist/ das die ähern sich nit wie am andern Korn befrüchtigen/ sunder eyn yeder knöpffichter stamm/ stoßt zů den seiten heraußer lange/ dicke/ unnd runde kolbechte ähern/ mit vilen fachen/ des graß verschlossen/ unnd mit dünnen feldern ingewickelt/ eyn yeder kolp so er emplößt ist/ hatt er etwann acht oder zehen zeilen/ mit hart züsammen gedrungenen körnern besetzt inn eyner ordnung. Die öberste spitzen der frucht kolben sind mit reynen zarten unnd langem haar geschmuckt/ etlichs weiß/ etlichs geel/ nach dem die frucht weiß oder rot ist/ damit ja solche frucht kolben herrlich unnd wol für den vogeln unnd gewürmen behüt unnd beschirmpt pleiben. Also wunderbarlich spilt unnd handelt Gottes dienerin/ die natur im jren wercken/ des wir uns billich verwundern müssen/ unnd den eynigen ewigen Gott unnd schöpffer im den Creaturen (wie sanct Paulus sagt) lernen erkennen etc. Die grosse runde stengel/ wann sie noch grün unnd safftig sind sie süsser/ dann keyn zucker. Würt spat/ nemlich imm Augstmonat zeitig/ gibt gůt schön weiß meel/ vñ süß brott/ doch etlicher massen eyns frembden geschmacks.

Von den namen.

Das welsch Korn (dann also nent man alle frembde gewächs/ so zů uns kommen/ mit dem namen Welsch) solt billich groß Tipha heyssen. Dieweil wir aber des namens aus der schrifft keyn zeügnus haben/ wöllen wir es frumentum Asiaticum tauffen. Dann imm Assyria/ jhenseit dem wasser Bactro/ wirt eyn solche grosse frucht gefunden/ deren granes oder körner den Oliven gleich groß wachsen/ das ich wol glauben kan/ dies welsch selbs bei eynem landtkremer/ solcher körner vier oder fünff gesehen hab/ mit der gestalt unnd farb dem obgesetzten korn/ aller ding änlich. Als ich nun mit fleiß nach solcher frucht forschet/ ward mir zů antwort/ sie

Theo. 8. cap.

namen und würckung. xxij

sie keme auß India/ möcht umb gelt keyn korn von jm bringen.

Was aber die frucht Tipha sey lißt man im Plinio unnd Theophrasto/ nemlich Tipha unnd Speltz/ sind aller ding dem Weyssen gleich/ vom selben ist droben under dem Weyssen gedacht/ von dem grösten Tipha her nach. Wir wöllen yetzund unser frembd korn Tipham magnam/ unnd Triticum ...

Von der krafft und würckung.

Ich hab noch zů zeit keyn besundere erfarung/ war zů diß gewächß inn der artznei dienlich sei vernommen/ außgescheyden/ das man von disem korn schön brott bacht.

Etlich machen auß dem reynen Weyssen meel brei/ wie mit andern früchten/ mit milch abbereyt.

Der safft von den grünen blettern/ ist eyn gůt leschung für alle hitz/ unnd sonderlich gůt für das rot lauffen.

Von dem Habern/cap.xxvj.

Inn etlichen Jnsulen müssen die innwoner alleyn des Haberns geleben/ da wechßt er auch on alle bauwung der ackerleüt. Plinius schreibt libro quarto/ capite decimo tertio/ et capite tricesimo/ die teütschen haben keyn ander gemüß inn jren kuchen weder Habermeel/ mag villeicht war sein im Algaw vñ Thurgaw/ sunst ist der Habern eyn speiß fütter der reyßpferdt im teütschen land/ umb welcher geul willen der Habern yetzunder am meysten gebawt würt/ unnd ist zwar der Habern nit eyn geringe oder verächtliche frucht/ vihe unnd leütten/ ja den krancken unnd gesunden. Dann so bald der doctor oder leibartzet/ dem siechen presthafften/ inn der kuchen die ordnung unnd regiment stellet/ ist der Habern mit seinem kern unnd meel mit das hunderst köchset/ zwar nit unbillich/ dieweil Habern zůr speiß als wol/ als zůr kranckheyt dienstlich erfunden ist. Inn verschinen jaren als grosse thewrung ware/ haben die innwoner imm waßgaw unnd Westereich aus Habern brott lernen bachen/ unnd das selbig nutzlich unnd wolschmackend befunden/ daher der Habern folgens inn solcher erfarung/ desto thewrer unnd werder worden/ wer will doch jetzunder imm land des Haberns gern emperen? Jch rede hie von zamen/ dann inn der schrifft der alten/ findt man zweyerley/ zam unnd wild.

Plin. li. 22. cap.

Der zame (von welchem wir hie schreiben) ist mit keymen/ graß/ halmen/ unnd knöpffen/ dem Weyssen gleich/ wie Dioscorides libro secundo/ capite octuagesimo quinto bezeügt. Die ähern schlieffen auch aus den grasichten scheyden/ thůn sich auß eynander/ als die Jube oder ähern am ror. Der spitzig somen des Habern hangt ledig/ zwischen uffgethonen heimlein oder flügelen der ähern/ ye zwey körnlin neben eynander/ als zwen zwilling/ doch ist deren eyns alzeit grösser/ dañ das ander/ haben bede lange granen außgespreyt/ unnd mit den flügeln uffgethon/ anzůsehen wie die Hewschrecken. Solche frucht ist gemeynlich mit den letsten uff dem felde/ dann

b iij sie

Fig. 2. One of the first discussions of maize by a European herbalist, Hieronymus Bock, in the *New Kreuterbuch* (1539).

is mostly dark purple or red. There is also white maize and much that is yellow and it might be that Pliny did not see all these other colors but only the dark purple which appears black. Maize has a stalk which, as he says, is like that of a reed and anyone who was not acquainted with the plant and had not seen it in the field before at full height would think it were a cane field. For the most part, maize [in the New World] is somewhat higher than the seven feet which Pliny describes. In some places it is very high, in others less so, depending on the fertility or goodness of the soil in which it is sown.

As for what he says about its being very high yielding, I have already pointed out that I have seen eighty, a hundred, and [even] a hundred and fifty faneagues harvested from one faneague planted. Pliny says that it is sown in humid places; the Indies are very humid. But to prove that maize needs to be planted in humid land or where there is a good supply of water, I mention that while Her Majesty, the Empress, was in Avila, during the time the Emperor was in Germany, I saw in that city, which is one of the coldest in Spain, inside a house a good plot of maize with stalks about ten hands high [80 inches high] as stout and as green and as beautiful as can be seen around here; near by was a well from which they watered it each day. I was really astounded, remembering the distance and difference in climate of this region from that of Avila . . . . The event took place in 1530 A. D.

An anonymous explorer who accompanied Cortés in his conquest of Mexico describes kernels with varying colors:[12]

The grain with which they make their bread is a kind of pea, and there is white, crimson, black and reddish. Planted, it produces a high cane like a half pike, which gives two or three ears where the grain is, as in Panizo or Panic grass.

Gómara describes the maize of Guatemala as being very large, and adds:[13]

Only one stalk grows from each grain. Often, however, one stalk bears two and three ears, and one ear bears 100, and 200, 400 and even as many as 600 grains. The stalk grows as high as a person and higher and is very thick. It bears leaves like our cane, but these are broader, longer, greener and softer. The plant matures in four months, on some lands in three, and on irrigated land in a month and a half, but this is not as good.

Acosta describes a similar plant:[14]

[Maize] grows upon canes or reeds; every one bears one or two grapes or branches, to the which the grain is fastened and although the grain is large, yet there are great many of them. In some clusters I have counted seven hundred grains. They must plant it with the hand one by one, and not very thick; it desires a hot and moist ground, and grows in great abundance in many places of the Indies. It is not strange in those countries to gather 300 *faneagues* or measures for one sown . . . . There is difference between maize varieties as there is among those of wheat; one is great and very nourishing, another small and dry, which they call *Moroche* . . . .

Although these explorers did not go into much detail about differences in maize varieties, they readily recognized the significance of the plant in the lives of the natives. They saw it used as a food in countless ways. Primarily, of course, they recognized its importance as a bread food. Oviedo entitles his chapter on maize "Concerning the Bread of the Indies Called Mahiz",[15] and he frequently uses the Spanish term for bread, *pan*, synonymously for *Mahiz*. Gómara explains in detail how maize bread was made:[16]

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[12] *Narrative of some things of New Spain*, p. 35. Ed. and trans. by Marshall H. Saville. The Cortés Society. New York, 1917. The original Spanish text has been lost, Saville's text being from a Spanish translation of the Italian of Ramusio.

[13] López de Gômara, Francisco. *La historia general y natural de las Indias, Lib.* 1, p. 289. 1552.

[14] *Op. cit., Lib.* 4, p. 254.

[15] *Op. cit., Lib.* 7, *Cap.* 1, p. 72.

[16] *Op. cit. Lib.* 1, p. 289.

> They formerly did not have any wheat throughout the Indies, which are another world; [it would be] greatly missed here [in Spain] because of its extensive use, but, nevertheless, the natives of those regions [America] never felt nor do not feel the need for it, since they all eat bread made of maize . . . [To prepare] this bread for eating, they cook the grain in water, mash, grind and knead it; and they either cook it, wrapped in leaves in hot ashes (because they do not have ovens) or they roast it over live coals. Others grind the grain between two rocks like mustard, for they do not have mills. This is very hard work not only because of the hardness of the grain but because of the length of time it takes, which is not like that for making wheat bread. And so the women spend a part of each day at work preparing it; it loses its harsh flavor and it soon is ready. In three days it spoils and even decays. It stains and hurts the teeth a great deal, and for that reason they take great care in cleaning their teeth.

There were variations on the methods of making bread. Sometimes for native nobles and other persons of high rank the bread was made from red maize and pressed to a wafer-like thinness. Equally common as its use in bread was the roasting of maize ears, which is frequently mentioned by the explorers. A gruel of maize boiled and thinned out with water was eaten by the Indians of Mexico for breakfast and was used by the Spaniards there as a healthful food for the sick.[17]

The explorers seem to have been impressed by the uses of maize for alcoholic beverages among the Indians, as these are reported in detail. Oviedo describes how the maize beer *(chichá)* was made:[18]

> All, for the most part, drink water, but no one dislikes wine. Rather, they are very fond of it. And they make as much *chicha* (which they call their wine) as they want, out of maize. This is their recipe for making it: they soak the maize and let it remain in water until it begins to germinate and swell up and some sprouts come out from that part of the grain which was attached to the ear. As soon as it has reached this point they cook it in good water, and after it begins to boil and to cook down they take from the fire the pot in which they cook it, and let it set until the grain settles. That day it is not ready to drink; but the second day it is more settled and they begin to drink some of it, although it is still somewhat thick. On the third day it is good and clear, because it is entirely settled. The fourth day it is even better, the color being like that of cooked Spanish white wine. It is an excellent beverage. The fifth day it begins to sour, and on the sixth it sours even more. On the seventh day it is vinegar and not fit to drink.

The kernels were frequently chewed by old Indian women and children to hasten the fermentation.[19] And Acosta[20] says it was a tradition among the Indians that the older were the women who did the chewing the stronger would be the liquor. Another type of wine was made from parched maize.[21] Revelry and drunkenness accompanied the drinking of these potions. As one of the *relaciones* said:[22]

> [The Indians] drink so much [maize liquor] that it makes them drunk. In order to get drunk they have parties in private houses with dancing to drums and crude instruments. It is a custom among the Indians not to drink this liquor alone; rather, they have all the glasses in pairs, and one person must take a drink himself from one glass and give his companion a drink from the other.

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[17] Clavigero, D. F. S., *The history of Mexico* 1:433.

[18] *Op. cit.* 3:136. 1853.

[19] Vázquez de Espinosa, Antonio. *Compendium and Description of the West Indies.* Trans. by Charles Upson Clark, in Smithsonian Inst. Washington, Misc. Coll. 102:426. 1942. The original Spanish ms. is unpublished.

[20] Acosta, *op. cit., Lib.* 4, p. 236.

[21] Vasquez de Espinosa, *op. cit.*, p. 426.

[22] *Ciudad de la Paz* in *Relaciones geográficas*, 2:71–72.

And such carousing often went on for days.[23]

In addition to its staple use in bread, there were a number of special food uses for maize. Maize bread was sometimes made with eggs added[24] and sometimes walnuts were mixed with the maize flour.[25] Tamales were also prepared.[26] The Indians of Peru obtained a cooking fat and an oil from maize kernels,[27] and sugar was prepared from the juice pressed from the maize stalk.[28] Amazed at all of the uses to which maize was put by the Indians, Acosta confirms the remark of a Spanish viceroy that the New World was rich in two things: "maize and cattle." "He was right," adds Acosta, "for these two things serve them as a thousand."[29]

How much maize meant in the lives of the Indians is revealed in the reports from the explorers on its use in ceremonies, and on various native customs related to the plant. The Aztecs worshipped a god of maize,[30] Cinteotl, and maize was an acceptable offering to their gods,[31] especially white maize and maize wine.[32] A gruesome sacrificial ceremony of a maize offering is vividly described by Oviedo:[33]

> . . . before the feast, they collect many fasces of maize, and they put them around the sacrificial pile. First come the high priests of the devil . . . then the chief, and next in line each of the leaders according to his rank, who offer themselves in sacrifice. With some rock knives they cut their tongues and ears and genitals, and cover the maize with their blood. Afterwards, they divide [the grain] among themselves . . . and they eat it as though it were something very holy.

Small communion wafers were made of maize in Peruvian religious ceremonies to the sun.[34] The Indians of Nicaragua maintained chastity during the maize season, from sowing to harvesting.[35] In some marriage ceremonies the bride held in her right hand an ear of maize to signify that she would take care of the household and food.[36] So precious was maize considered in Mexico that any one who stole maize from a field became the slave of the owner of the field.[37]

Native methods of sowing are frequently reported in detail, including the account given by Oviedo and copied by Matthiolus (see below).

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[23] Acosta, *op. cit., Lib.* 4, p. 255.
[24] Clavigero, *op. cit.*, p. 212.
[25] du Pratz, L. P. *Histoire de la Louisiane*, 2:383.
[26] *Narrative of some things of New Spain*, p. 36.
[27] Acosta, *op. cit., Lib.* 4, p. 256.
[28] Von Humboldt, A. *Personal narrative of travels to the equinoctial regions of America during the years 1799–1804*, 2:400–401.
[29] *Op. cit., Lib.* 4, p. 256.
[30] Clavigero, *op. cit.*, p. 253.
[31] *Descripción de la Tierra Rucanas Antamarcas, Relaciones geográficas*, 1:207.
[32] *Relación de Caguasqui y Quieca, Ibid.* 13:126; and Oviedo, *op. cit., Lib.* 49, *Cap.* 4, p. 389. 1535.
[33] *Op. cit., Lib.* 42, *Cap.* 11, p. 98. 1855.
[34] Acosta, *op. cit., Lib.* 5, pp. 391–392.
[35] Oviedo, *op. cit., Lib.* 42, *Cap.* 11, p. 101. 1855.
[36] du Pratz, *op. cit.* 2:392.
[37] *Narrative of some things of New Spain*, p. 45.

MAIZE IN THE GREAT HERBALS

Maize is reported in Europe very early after the Discovery. Columbus in his report on the Third Voyage writes that the plant was then growing in Spain.[38] And in the 1525 edition of Oviedo's *Historia*, there is a mention of maize growing near Madrid.[39]

Fig. 3. Woodcut of maize from the work of the Italian herbalist, Matthiolus (1570). Note the similarity between this illustration and fig. 1. At the right is a stalk that appears to be a stylized copy of the plant in Fuchs' cut (fig. 4).

Some time in the 1530's, maize began to attract the interest of the European herbalists, who, carrying on a medical tradition of almost 2000 years, published descriptions and uses of plants, chiefly those with medicinal properties. The discussions of maize in these great plant books give us a detailed and illustrated record of some of the European types of maize during the Renaissance. For the first thirty years in which maize is discussed in the herbals there is no mention that it had been brought in from America. Although reports of maize by the Spanish explorers and chroniclers were being published in Europe at the time, they were apparently slow in their spread over Europe. During this period, the general opinion among the herbalists was that maize had been brought into Europe from the Orient. It was not until 1570, with the herbal of the Italian Matthiolus (1570, p. 305), who had seen the text of Oviedo's *General and Natural History*, that an American origin for maize is suggested.[40]

Maize was first reported in the herbals in the work of the German herbalist, Jerome Bock (1539, fols. 21–22). He calls the plant *Welschen Korn* or "strange grain." The plant, he explains, is new in Germany and probably came from India:[41]

[38] See footnote 3.
[39] Von Humboldt, *op. cit.* 2:394.
[40] The two texts are compared below in the discussion of the Matthiolus herbal.
[41] See text in fig. 2.

> All foreign plants are called *Welsch* but this really should be called Typha. Because we have no written proof, we want to name it *Frumentum Asiaticum* [Wheat of Asia] because in Assyria . . . such a fruit is found whose grains or kernels grow as large as olives and this I can easily believe. I myself have seen four or five such grains at a country merchant's—grains similar in shape and color to those discussed here. When I made a thorough inquiry about such a fruit, I was told that it came from India. . . . One reads in Pliny and Theophrastus what the fruit Typha is: Namely Typha and Spelt are similar in all respects to wheat . . .

Bock describes a plant that bore ears of eight to ten rows with kernels either red, brown, yellow, or completely white. On the whole, Bock found the plant startling. He marvels at the long "threads"[42] that grow out from the ears and he suggests they function as a scarecrow device to keep birds and vermin from destroying the plant. He says it is mysterious how the plant is fertilized, for ears enclosed in many sheaths sprout from the sides. Bock remarks that the juicy stems of the plant are "sweeter than any sugar," and he prescribes the juice from the green leaves as a remedy for erysipelas. He does not include an illustration in this early edition.

For one to understand the full meaning of Bock's text, and that of the other herbalists mentioning maize, it must be remembered that the great herbals of the Renaissance were the culmination of a long tradition. Early in the history of peoples an interest is shown in plants for their medicinal uses. Among the Greeks, from whom western Europe has derived much of its heritage, this interest was concentrated in the rhizotomists, a class of plant-gatherers whose beliefs and traditions served as the basis for the herbal—a collection of descriptions of plants put together for medical purposes. The earliest such collections date from the second century B.C.[43] In the century preceding, however, a pupil of Aristotle, Theophrastus of Eresus, made a philosophic study of plants as plants and not merely for their medical applications. He included, nevertheless, in his *Enquiry into Plants*—as his only extant work is called—a description of the flora of the Mediterranean region, with accounts of the uses of a number of the plants.[44] As pointed out above, Bock attempts to associate maize with one of the plants that Theophrastus describes.

Two other ancient works were consulted by the Renaissance herbalists, who, in order to recover the old remedies, tried to associate the plants of western Europe with those mentioned in the ancient books.[45] The *Natural History* of Pliny (Secundus) was so influential throughout the Middle Ages that eighteen editions were printed in the fifteenth century and forty as late as the sixteenth.[46] Pliny, like Theophrastus, mentions a grain which the sixteenth-century herbalists attempt to identify with maize. The original passage from Pliny is quoted by Oviedo above.

Dioscorides, a Greek contemporary of Pliny, published an herbal *Materia*

[42] The styles from the female ovaries of the corn plant, commonly called "silks."
[43] Singer, Charles. *From magic to science*. pp. 174–177.
[44] Arber, Agnes. *Herbals*. p. 7.
[45] Greene, E. L. Smithsonian Inst. Washington, Misc. Coll. 54:223.
[46] *Ibid.*, p. 158.

Fig. 4. The first illustration of maize in the herbals. From *De historia stirpium* of Leonhard Fuchs (1542).

medica, which became the medical bible of the Middle Ages. His work was of such consequence that "everyone who undertook the study of botany or the identification of medicine swore by his words. Even as late as the seventeenth century both the academic and the private study of botany may almost be said to have begun and ended with the text of Dioscorides."[47]

These early herbals were handed down to the Renaissance herbalists by copying and re-copying throughout the Middle Ages. Changes from the originals were chiefly additions, in some manuscripts, of glossaries listing the local dialectal names for the plants that were described. Some of the manuscripts had been copied and recopied for over a thousand years.[48]

The botanical renaissance was started in the first half of the sixteenth century by the "German Fathers of Botany," a group of herbalists among whom was Bock, whose works represent a return to nature.[49] The first of these was Otto Brunfels, whose *Herbarum vivae eicones*, published in 1530, is significant because of its realistic woodcuts which led the way for life-like portrayal of plants. He makes no mention of maize.

Bock, the second of the German fathers, whose chapter on maize has been discussed above, published his first herbal in German without illustrations. Later editions,[50] both in German and Latin, include the same material on maize but are illustrated with a stalk taken from the woodcut of maize in the work of Leonhard Fuchs, the next herbalist after Bock to discuss maize. (See fig. 7).

Fuchs' herbal, *De historia stirpium*, first published in Latin in 1542, presents a type of maize that is very much like that discussed by Bock.[51] His woodcut of the maize plant (see fig. 4), of folio size, is the first illustration of the whole plant to appear in Europe.[52] By 1542, maize had evidently become common in Germany, for Fuchs reports that "it is now growing in all gardens." He describes a plant with ears of eight to ten rows and bearing red, white, yellow, or purple kernels. Prop-roots (which might be expected to have sprouted from the lower nodes of the plant if it had been brought into Temperate Europe from some Tropical region of the New World) are neither mentioned in the text nor illustrated on the plant he portrays. Fuchs calls the plant *Frumentum Turcicum* and says that it was brought into Germany from Asia by the Turks, who were reported to have used it when other grains were scarce:[53]

> This grain, like many others, is one of those varieties which have been brought in to us from another place. Moreover, it came into Germany from Greece and Asia, whence it is called "Turkish grain," for today the huge mass of Turkey occupies the whole of Asia, and the Germans, noting the place of its origin, call it Turckisch korn.

[47] Sprengel, Kurt. *Historia rei herbariae*, I, as quoted by Greene ('00), p. 151.
[48] Singer, *op. cit.*, pp. 184–185.
[49] Arber, *op. cit.*, p. 52.
[50] *Kreuter Buch*, 1546, p. 249; 1560, p. 243. Tragus, *De stirpium* . . ., 1552, pp. 650–652.
[51] p. 824.
[52] A woodcut of maize is reported to have been included in the *Historia* of Oviedo (1535) according to Miall, *op. cit.*, p. 66. A check of the original texts of Oviedo's work in the Missouri Botanical Garden Library and in the Newberry Library does not reveal such an illustration. A reproduction of this cut in Ramusio (see footnote 44) is given in fig. 1.
[53] Fuchs, *op. cit.*, p. 824.

The term *Turcicum* during this period was probably used to mean "foreign." The Turks, attacking various parts of Western Europe, had introduced a number of new products there. Consequently, plants, animals and articles alien to a particular location were frequently assumed to have been brought in by the Turks and were labeled "Turkish."[54] From a similar misconception, the American bird, *Meleagris gallopavo gallopavo*, is commonly called a Turkey.[55]

Valerius Cordus, the fourth of the German herbalists, who was outstanding in plant description, is the first to recognize prop-roots in the maize plant:[56]

> It is supported by many fibrous roots from the sides, to which there are added other supports which grow out on all sides from the lowest node and are sent down into the ground. A cornfield is supported by these against strong wind.

Cordus' text, illustrated by a stalk copied from the cut of Fuchs, reads like a modern taxonomic description. He describes the morphology of the plant in fine detail. The ears have eight to ten rows and bear kernels that are either golden or yellow, and he says that an extraordinary type was found with red and black kernels. Cordus makes no mention of the origin or uses of the plant. By the name *Triticum Bactrianum*, which he calls maize, he associates the plant with the *Triticum* of Theophrastus.[57]

Two other German herbalists, whose works appeared at the end of the sixteenth century, present discussions of maize. A pupil of Brunfels, Tabernaemontanus, whose German name was Jacob Dietrich of Bergzabern, produced an herbal, *Neuw Kreuterbuch* in 1588, in which he describes two types of maize.[58] He discusses each in a separate chapter: one entitled *Frumentum Turcicum*, the other *Frumentum Indicum*. The first type has eight to ten rows with red, white, yellow, or purple kernels. It has no prop-roots (as might occur in plants brought in from the tropical regions of America), and its possible origin is not mentioned. The second type, labeled *Frumentum Indicum*, has broader leaves and ears with higher row numbers, and bears several rows of prop-roots. It has kernel colors of black, brown, white, yellow, and purple. This plant, Tabernaemontanus says, was brought from the New World via Spain. Twenty-three woodcuts are presented in Chapter IV of the herbal: one of an entire plant, four of individual ears to illustrate the first type of plant, one of the plant of *Frumentum Indicum*, and seventeen of its type of ears.

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[54] Information supplied by Dr. Horst Janson, of the Washington University department of art and archaeology, who is making a cultural study of the period.

[55] Information supplied by Dr. Hampton Carson, Washington University department of zoology. Fuchs uses a number of terms still in use today to describe the corn plant and other grasses. The word *culmus*, modified from the Greek *calamos*, from which comes our term "culm", is his word for the stems of grass-like plants. In an introductory glossary of "difficult" terms, he defines a spike as that which a culm bears at its summit, and in accordance with this definition, applies the term to the entire corn tassel which today is known as a panicle. (See Greene, *op. cit.*, p. 275.)

[56] *Annotationes*, p. 112. 1561.

[57] *Op. cit.*

[58] 1:758–764.

Figs. 5–7. Reduced copies of the original cut of Fuchs' (fig. 4): Fig. 5. Reduction in the Fuchs herbal of 1545, copied in reverse of the original. Fig. 6. Reduction in the Fuchs herbals of 1549, 1551, and 1553, in reverse of fig. 5 and probably a copy from it. Fig. 7. Copy in the herbal of Bock (1546).

Two years earlier, Joachim Camerarius published an edition of the herbal of the Italian Matthiolus.[59] In this work Camerarius presents a dwarf maize plant to illustrate the text (see fig. 10). This is discussed below.

The herbal in the Low Countries centered around the cooperative work of three herbalists.[60] The first and most famous of these, Rembert Dodoens (in Latin, Dodonaeus), published his *De frugum historia* in 1552, and later editions in 1566, 1583, and 1616. In all of his editions Dodonaeus describes an ear of eight to ten rows, bearing, according to various editions (see Table III), either red, white, yellow, brown, or purple kernels. In the editions of 1566 and 1616 he says the stalk is five to seven feet high and bears three to four ears. His material on the origin and uses of maize differs in the various editions. In the edition of 1552, he calls maize *Milium Indicum*, associating it with the plant of Pliny, but adds:[61]

> This season it is called Turkish or Saracen grain because it is believed to have been brought in from Asia or Greece which are under the power of the Turks.

Bread made from this grain, he says, is binding and offers no nourishment to the body.

In the edition of 1566, he disagrees with Valerius Cordus' name for the plant, *Triticum Bactrianum*, and points out that Pliny spoke of a grain whose size would equal "one of our ears." He quotes some of the ancient descriptions and concludes:[61]

> Turkish corn is unlike these—it is not *Triticum Bactrianum*, but should be given a new name *Triticum Turcicum*. Some day some Oedipus will point out its ancient name or be able to show that it was described somewhere by the ancients or was at least known to them.

In this edition he presents the first original drawing of the maize plant since that of Fuchs in 1542 (see fig. 8). In the editions of 1583 and 1616, he denies an Oriental origin and says maize was brought in from the New World:[62]

> By no means [did it come] from Asia which is subject to the Turkish Emperor (as is commonly believed) or from the Orient, but from the West—from America and neighboring islands brought first into Spain and then into other states of Europe.

Another Low Country herbalist and a close friend of Dodonaeus,[63] Jules-Charles de l'Escluse (Clusius), edited the *Exoticorum libri decem* (1605), which included material of the New World chroniclers, García de Orta, Christophorus a Costa, and Nicolaus Monardes. In discussing the bread of the New World, Monardes presents a short paragraph on maize (see below).

The chief work of Mathias de l'Obel (Lobelius), the third of the Belgian herbalists, was *Plantarum seu stirpium historia* (1576), which was translated into Flemish in 1581 under the title *Kruydtboeck*. In this last work l'Obel presents a woodcut of a maize plant with six rows of prop-roots and labels it Indian corn

[59] Matthiolus, Petrus, *De plantis epitome . . . aucta et locupletata, a D. Ioachimo Camerario.* 1586, p. 186.
[60] Arber, pp. 79–92.
[61] *Op. cit.*, p. 35.
[62] *Op. cit.*, p. 509.
[63] Arber, *op. cit.*, p. 82.

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Fig. 8. Illustration of maize in the 1566 edition of the herbal of Dodonaeus.

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Fig. 9. This cut, in the herbal of l'Obel (1581), is the first to illustrate prop-roots.

(see fig. 9). He distinguishes this from Turkish Corn, which he illustrates with the cut in the Dodonaeus edition of 1566. He describes ears with colored kernels similar to those reported by previous herbalists (see Table III) and does not go into detail about specific differences between the two plants. He disagrees with the statement of the Italian herbalist Matthiolus that maize came from America because, he says, the plant was mentioned by Pliny and others of the ancients who had never been to America.[64] Later (1605), he mentions a New World origin.

The most outstanding of the Italian herbalists, Petrus Matthiolus (Pierandrea Mattioli), was apparently the first of the European herbalists to have seen the literature of exploration. He is the first of the herbalists to deny an Oriental origin for maize and to suggest that the plant had been brought into Europe from

[64] *Op. cit.*, pp. 50–51.

America.[65] In his edition of 1570, where he first discusses maize, he says:[66]

> This type of grain, which they wrongly call *Turcicum*, can be numbered among the varieties of wheat. [It has been named] incorrectly, I say, because it ought to be called *Indicum*, not *Turcicum*, for it was first brought from the West Indies, not out of Turkey and Asia, as Fuchs believed.

Matthiolus was evidently influenced in this belief by the text of Oviedo. He includes in his discussion Oviedo's account of the methods used by the Indians to sow maize:

OVIEDO, 1535

> five or six Indians stand . . . a step away from each other in a row and with a stick or macana [wooden sabre edged with sharp flint] they strike the earth, shake the stick in order to open up the earth and then take the stick out. In the hole they throw with their left hand four or five grains of maize which is taken from a small bag tied about the neck. With his foot he closes over the hole containing the grains lest parrots or other birds eat them. Then they take another step forward and do the same thing, proceeding throughout the field in the same way. All the Indians sow in a row until they arrive at the end of the piece of land they are sowing [continuing thus] until they have finished the whole field. (folios 71–72).

MATTHIOLUS, 1570

> The Indians sow this seed, which they call Malitz, in this way. A number of them, in a straight line, at equal distances, go down into the field. Then they make a hole with a sharp stick in their right hand and with their left hand they throw in four or five grains in the hole covering it over with their foot lest parrots eat the seed. So with measured step backwards, they sow the whole field with grain. But before they entrust the seed to the ground they soak it in water for two days, and do not sow it unless the ground has been previously rained upon. [The plant] sprouts within a few days and is harvested in India in 4 months. (p. 305).

The last three sentences in the above excerpt from Matthiolus indicate that he had seen other sources, besides Oviedo, in the literature of exploration. The maize ear which Matthiolus illustrates is very similar to that found in the Ramusio translation of Oviedo[67] and, according to one student,[68] was in the original. Matthiolus describes ears with red, black, white, brown, purple or yellow kernels and having eight to ten rows. He calls the plant *Frumentum Indicum* and gives *malitz*[69] as the name for the plant in the New World. He also refers to a 40-day corn, and a two-month corn, both of which are mentioned widely in the literature of exploration. Later editions of Matthiolus (see bibliography) include for the most part the same text.

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[65] The Spanish herbalist Monardes, describing the flora of the New World, reports maize growing in America in his herbal of 1569 (see footnote 71). Because he does not describe or illustrate the plant or associate it with the common names for it in Europe, the material differs very little from other references in the literature of exploration.

[66] *Op. cit.*, p. 305.

[67] *Della naturale et generale historia dell'Indie, dove si tratta dell'agricoltura.* Venice, 1606, III, *Lib. 7*, p. 110.

[68] Miall, *op. cit.*, p. 61.

[69] Matthiolus probably misread the "h" of *mahiz* for an "l". The modern term has been studied in detail: "The word 'maize' is first recorded by Oviedo as the word for corn in the Cuban dialect of Arawak and [Oviedo] gives the original form in two spellings: *'maisi'* and *'majisi'* . . . [The phonetic interpretation of these spellings] is that the word starts off with *mah-*, which is followed by *-hi-* (this syllable in colloquial Spanish reduced to the second member of a diphthong), and the word is then closed by a third and final syllable *-si-*. By giving two spellings Oviedo makes it possible to know exactly what the pronunciation was. Though the Arawak language has for centuries been dead in the islands, there are Indians on the mainland of South America, for instance, in Guiana, who still speak a different dialect of it, and in their dialect, if we look for the

Castor Durante, another Italian herbalist, seems to have taken much of his texts from Matthiolus.[70] He labels his discussion *Grano d'India* (Grain of India) and, writing of the use of maize in the New World, quotes from Matthiolus. Durante describes an ear of eight to twelve rows, with red, white, and yellow kernels.

The Spanish herbalists, describing for the most part the flora of America, include the maize of the New World. The first of these, Nicolaus Monardes, published in 1569 his *Historia medicinal*, a work without illustrations and containing only a general reference to maize:[71]

> . . . bread is made of maize . . . They grinde it, and with water they knede it, and in a frying panne of earth they bake certain cakes which they make of it, and it must be eaten freshe, as soone as it is made; for being dry it is sharpe and troublesome to swallow down, and doeth offende the teeth . . .

Another Spanish herbalist, Francisco Hernández,[72] presents a detailed picture of the uses of maize in Mexico, giving much the same information that is in the literature of exploration. For the first time in the herbals, Hernández uses the Aztec name for maize, *tlaolli*, and describes it as having black, white, purple, dark blue, golden yellow or mixed-colored kernels. To illustrate his herbal he uses woodcuts taken from the l'Obel herbal of 1581.

Portuguese herbalists chiefly describe the flora of Portuguese dominions in the Orient and do not make reference to maize.

Maize is first mentioned in Switzerland in the herbals of Caspar Bauhin and of his brother Jean. Caspar's discussion of the plant in his *Phytopinax* (1596, p. 55) and *Pinax* (1623, pp. 24–26) is chiefly an attempt at the systematization of the descriptions of previous writers. He includes a description of a plant (1623, p. 25) with grains of "tender infolded skin", which might indicate pod corn. His brother Jean treats maize in somewhat the same way,[73] presenting a compendium of previous descriptions. Another Swiss student of plants, Konrad Gesner, had projected an herbal but it was not finished before his death. The 1500 drawings he prepared for the work were sold to the German herbalist Camerarius[74] and one of these may be the source of the woodcut of maize in Camerarius' herbal of 1586 (see fig. 10).

There were very few herbals compiled in France, and most of them are translations.[75] The few original French works deal almost entirely with pure systematic botany and, as far as I know, do not discuss maize.

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word for corn, we find *marise*." Quoted from: Harrington, John P. Origin of the word "maize." *Wash. Acad. Sci. Jour.* 35:68. 1945.

[70] *Herbario Novo.* 1602, pp. 217–218; 1617, pp. 217–218; *Hortulus Sanitatis.* 1609, pp. 397–399.

[71] Frampton, John. *Ioyfull newes out of the new-found worlde*, p. 104. The Spanish original was not available.

[72] *Rerum medicarum Novae Hispaniae, Thesavrvs* . . . . pp. 242–247.

[73] *Historia plantarum*, 2:453–454. 1651.

[74] Arber, *op. cit.*, pp. 110–111.

[75] *Ibid.*, p. 119.

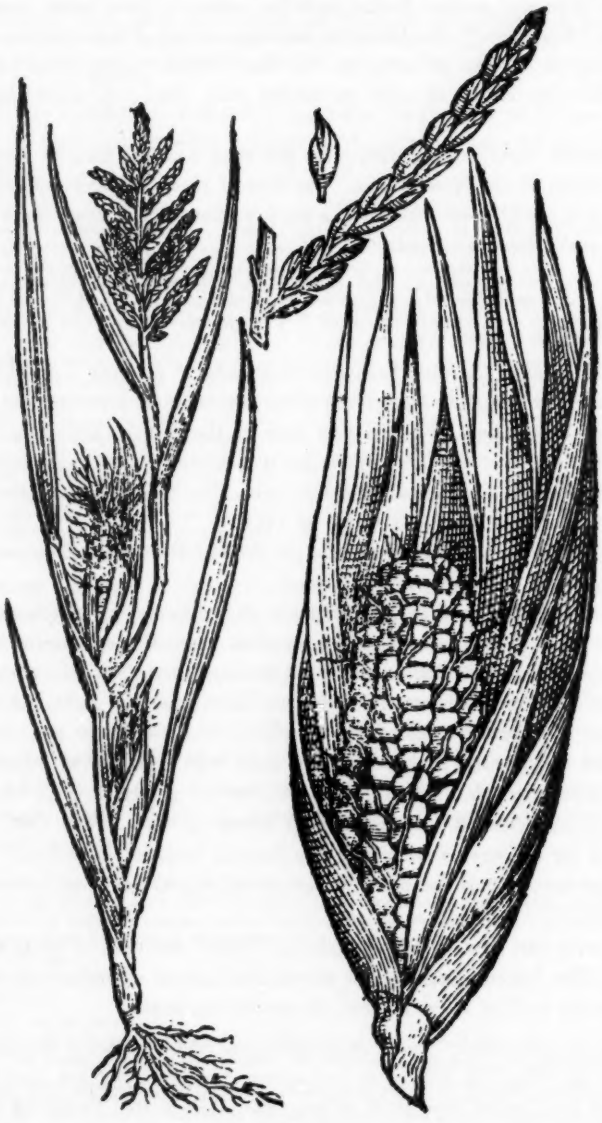


Fig. 10. A dwarf plant and enlarged segments in the herbal of Matthiolus, edited by Camerarius (1586). This freak, labelled Indian Corn, was illustrated probably as a portent.

The first discussion of the plant in England is in a translation of the *Cruydeboeck* of Dodonaeus[76] by Henry Lyte in 1578.[77] The *Herball* of John Gerarde,[78] the most famous of the English herbalists, is also a translation of Dodonaeus (*Pemptades*, 1583), arranged according to l'Obel. Gerarde adds, however, some original material in his discussion of maize. He says he has grown maize in his own garden and points out in "English it is called Turkey corne and Turky wheate." He suggests that the plant came from both America and Asia:[79]

> These kinds of graine were first brought into Spaine, and then into other provinces of Europe out of Asia which is the Turkes Dominions, as also out of America and the Ilands adioyning from the east and west Indies, and Virginia and Norembega, when they use to sowe or set it, and to make bread of it where it groweth much higher than in other countries.

He describes a maize ear which is of eight to ten rows and bearing red, white, yellow, or purple kernels. Four woodcuts from the 1588 edition of the herbal of Tabernaemontanus illustrate the text. The woodcut labeled *Frumentum Indicum* by Tabernaemontanus in his herbal of 1588 is here labeled *Frumentum Asiaticum*, Corne of Asia; but the cut which Tabernaemontanus labeled *Frumentum Turcicum* bears also that label in Gerarde's work.[80] In addition, Gerarde presents six woodcuts of ears from the Tabernaemontanus herbal with their original captions. In the 1636 edition of the *Herball*, Gerarde revises his original statement concerning the origin of maize:[81]

> These kinds of grain were first brought into Spaine, and then into other provinces of Europe: not (as some suppose) out of Asia Minor, which is the Turks Dominions; but out of America and the Islands adioining, as out of Florida, and Virginia or Norembega, where they use to sow or set it or make bread of it, where it grows much higher than in other countries.

John Parkinson, a later herbalist, discusses two types of maize in his *Theatrum Botanicum*:[82] (1) "*Frumentum Indicum vel Turcicum vulgare*, the usuall Indian or Turkie wheate," and (2) "*Frumentum Indicum alterum sive minus*, the other lesser Indian wheate." The first, which he says came "from the East and West Indies," is of six to ten rows and has blue, white, or yellow kernels and the plant bears two or three ears. This plant illustrated by the cut from the 1566 edition of the herbal of Dodonaeus (fig. 8) was, according to Parkinson, prevalent in England. It was without prop-roots. Parkinson points out that the maize plant with prop-roots illustrated in the herbal of l'Obel of 1581 is different from the plant he describes:[83]

> Lobel expresseth the figure of another sort as he thinketh because as hee saith it grew greater and higher, and the roote grew greater, *and with more separate tufts*, the roote not differing in anything else; but I thinke it no specificall difference, not understanding by any that it is taken for another sort, and, therefore, I have omitted it.

[76] *Posteriorum trium . . . de stirpium historia*, etc. 1554.
[77] *A nievve herball*, pp. 463–464.
[78] *The herba. or generall historie of plantes.* 1597.
[79] *Ibid.*, p. 77.
[80] *Ibid.*, p. 75.
[81] *Ibid.*, p. 82.
[82] 1640, pp. 1138–1139.
[83] *Ibid.*, p. 1139.

The second type, Parkinson says, is "not halfe so high or great, the ears likewise are not halfe so bigge." This plant, he adds, is "a stranger, and seldome seene with us."[84] Parkinson's theory of the origin of the plant is especially interesting because he observed a fact—that maize cannot grow wild—which has stimulated modern biological interest in the plant:

> Matthiolus, Dodonaeus, Lugdunensis and others who condemne Fuchsius for calling it *Frumentum Turcicum*, according to his countries dialect are found more just to be blamed themselves, for no doubt but this very *Indian* Wheate which plentifully is found to grow in all the tract of the West *Indies*, yet not found naturall in any place, but planted everywhere by the natives, & is the same with Theophrastus and Pliny their *Frumentum* or *Triticum* and *Milium Bactrianum Indicum*.[85]

That Parkinson had seen the work of Acosta is evidenced by the following statement:[86] " . . . Acosta saith the Spaniards in the Indies or the Indians call maize *Moroche;* the drinke made of *Maiz* is generally in the Indies called *Chicha*, but by some *Acua*."

Then, speaking of the "Vertues" of the plant, Parkinson writes:[87] ". . . Acosta saith that by feeding too much on maize it engenders grosse blood, which breedeth itches and scabbes in those that were not used to it."

TABLE I

NAMES IN THE HERBALS FOR MAIZE

Welschen Korn
Bock, 1539
Frumentum Asiaticum
Bock, 1539
Gerarde, 1597
Frumentum Turcicum (and variations)
Fuchs, all eds. 1542–'95
Bock, 1546, '52, '60
Lonicerus, 1551
Dodonaeus, 1563, '66, '78, '83, '86, 1644
Cordus, 1561
L'Obel, 1576, '91, 1605
Tabernaemontanus, 1588, 1613, '64
Bassaeus, 1590
Gerarde, 1597, 1636
Durante, 1602, '09, '17
Parkinson, 1640
Chabraeus, 1666, '77
a Turre, 1685
Matthiolus, 1696
Triticum Bactrianum
Cordus, 1561
Frumentum Indicum (and variations)
Cordus, 1561
Matthiolus, 1570, '71, '83, '86, 1674, '96
L'Obel, 1576
Dodonaeus, 1586
Camerarius, 1586
Tabernaemontanus, 1588, 1613, '64
Bassaeus, 1590
Durante, 1602, '09, '17
Parkinson, 1640
Bauhin, 1658
Boccone, 1674
Milium Indicum (Plinianum)
Dodonaeus, 1552, '53, '54
L'Obel, 1591, 1605
Maizium (and variations)
Matthiolus, 1570, '83, '86, '98, 1611, '96
Monardes, 1596
Dodonaeus, 1583
Cesalpinus, 1583
Tabernaemontanus, 1588, 1613, '64
Camerarius, 1586
L'Obel, 1591, 1605
Durante, 1602, '09, '17
Clusius, 1605
Gerarde, 1636
Hernández, 1651
Bauhin, 1658
a Turre, 1685
Tlaolli
Hernández, 1651
Triticum Peruvianum
Chabraeus, 1666, '77

[84] *Ibid.*, p. 1138.
[85] *Ibid.* Parkinson's reference to "Lugdunensis," above, is not clear. The French editions of Matthiolus (1561 and 1572) were published at Lyons.
[86] *Ibid.*, p. 1139.
[87] *Ibid.*

TABLE II

PLACE OF ORIGIN OF MAIZE ACCORDING TO THE HERBALS

India
Bock, 1539
Lonicerus, 1551

Greece or Asia held by the Turks
Fuchs, 1542–'95 (all eds.)
Lonicerus, 1551
Dodonaeus, 1552, '63, '66, '78, '86, 1644
Gerarde, 1597
Bauhin, 1658

Turkey
Bock, 1546, '52, '60

New World
Matthiolus, 1570, '83, '86
Dodonaeus, 1583, 1616
Camerarius, 1586
Gerarde, 1597, 1636
Durante, 1602, '09, '17
L'Obel, 1605
Bauhin, 1658

New World via Spain
Dodonaeus, 1583, 1616, '44
Tabernaemontanus, 1588, 1613, '64

TABLE III

COLORS OF KERNELS

Herbal	Red	Black	Brown	Blue	White	Yellow	Purple
Bock, 1539–60 (inc.)	X		X		X	X	
Fuchs, 1542–95 (inc.)	X				X	X	X
Lonicerus, 1551	X				X	X	X
Dodonaeus, 1552	X				X	X	X
1563	X		X			X	
1566	X				X	X	X
1578	X		X		X	X	
1583, 1616	X				X	X	X
1586			X		X	X	
Cordus, 1561	X	X				X	
Matthiolus, 1570	X	X			X	X	X
1571		X	X		X		
1583		X	X		X	X	X
1586	X		X		X	X	
1696	X		X		X	X	
L'Obel, 1576		X					
1581	X		X			X	
1605				X			X
Camerarius, 1586	X	X			X		
Tabernaemontanus, 1588, 1613, '64							
Indicum	X	X	X	X	X	X	X
Turcicum	X				X	X	X
Bauhin, 1591					X		
1596	X		X	X		X	X
1651				X		X	X
1658					X	X	X
Gerarde, 1597, 1636	X				X	X	X
Durante, 1602, '09, '17	X				X	X	
Parkinson, 1640				X	X	X	
Hernández, 1651		X		X	X	X	X
Chabraeus, 1666, '77		X			X	X	X

WOODCUTS OF MAIZE IN THE HERBALS

Most of the Renaissance herbals studied here contain one or more woodcuts of maize. They generally accompany discussions of the plant in the texts and give us a rather clear picture of some of the types of maize in Europe in the sixteenth century. The illustrations are extremely realistic. They are not like those handed down from the Middle Ages, which, after being copied over and over again for hundreds of years, show only vague outlines of the original plants. Such a tradition ended when Dürer, and other great Renaissance masters, used the woodblock as a serious medium for their art. By their precision and realism they stimulated other competent artists to draw for the blocks of the herbalists.[88] They present plants in their natural state and with their individual peculiarities. Some of the artists went to extremes of realism. One, for example, went so far as to include the wilted leaves and bent stems of the herbarium specimens he used as models.[89]

Realistic as the woodcuts are, they supply us with much information about corn of this period, which is not in the herbal texts. Some characteristics, only recently found significant in classifying the plant, are presented clearly in the prints. These include ear shape, presence or absence of prop-roots, and "flag leaves" (the corn-breeder's nickname for leafy bracts [see Brown and Anderson, '47]), types of tassel branching, breadth of leaves, and other features. The herbalists, of course, did not describe these characteristics precisely for they had neither the scientific knowledge nor terminology necessary, nor the intention to do so. The function of most of the herbals was not to further the new science of botany or taxonomy, but to allow readers to associate the plants of their locality with those used in the ancient medicines. Therefore, to us who study the morphology of maize of this time, the cuts are especially important. Much that the herbalists did not describe in words, they have handed down to us through these drawings.

Despite their realism, the woodcuts are not exact depictions. There were some technical limitations in their making which prevented complete naturalism. It was difficult, for example, to present very fine detail of plants both because of the thickness of the woodcut line and the lack of pains taken in printing. The line was about 250μ—a breadth that would not allow the drawing of hairs, stamens, or parts of small florets less than 1–2 mm. in diameter.[90] Besides, the cuts were intended for mass printing to illustrate books, and detail was not given the same careful attention as in cuts for single prints. Fine features of the corn plant, such as tassel spikelets, suffered as a result. It was also hard to draw round features on the rectangular block. In many herbals, trees are drawn with square crowns,[91] and in some drawings of maize, such as in fig. 8, the long lateral leaves are bent at the sides and the roots squared off unnaturally.

The prints also have some errors. Drawn in a period when plant sexuality was not understood, the silks on the ears in almost all prints come out from the

[88] Arber, *op. cit.*, p. 202.
[89] Hans Weiditz, the artist for the *Herbarum vivae eicones* of Otto Brunfels (1530).
[90] Church, A. H. Brunfels and Fuchs. Jour. Bot. 57:233–244.
[91] Arber, *op. cit.*, p. 215.

tips of the cobs, rather than from each kernel. As pointed out above, one herbalist suggested that the silks functioned as a "scare-crow" device to keep away preying birds! In Fuchs' cuts (fig. 4) the top two leaves on the second shoot from the right are drawn opposite instead of the natural alternate arrangement. Such errors served a useful purpose in this study in revealing copies and are discussed in more detail below. Many of them can be explained partially by the lack of knowledge of the corn plant at that time, and partially by a possible lack of cooperation between the various woodcut craftsmen. Three different craftsmen sometimes worked on each cut: the artist who made the original drawing, another craftsman who drew it on the block, and a sculptor who cut out the wood.[92] When there was little close-working among the three, a misunderstood detail might have been misrepresented.

It was a common practice among the herbalists to borrow, and sometimes even to copy, each other's prints. Most of the drawings of maize in the illustrated herbals studied here are reprints, and a few are copies. A survey was made of all of them to find the first plant of each original cut modelled after an actual maize plant. Since some of the cuts were reprinted for over 100 years, first prints were sought in order to date the depicted maize more accurately. Originals are more valuable than copies in such a morphological study as this, because, in the course of copying, the original figures might have been changed, either through misinterpretation or stylization.

In detecting reprints, like drawings were grouped together and then examined minutely to determine if similar prints had actually been made from the same block. Each print has a number of peculiarities, such as broken lines, which were compared in suspected duplicates. Some reprints had to be traced through as many as ten herbals extending over a century.

Each of these first [93] prints was then compared to determine if any were copies. The test for originality was not only distinctly different artistic features, but biological evidence that each print had been drawn from an actual maize plant as model. Some of this evidence is in the form of new biological features not found in previous cuts. For example, the cut in the 1566 edition of the herbal of Dodonaeus (fig. 8) presents among other original features "flag" leaves. The cut of l'Obel, in his edition of 1581 (fig. 9), shows prop-roots not found in earlier cuts. Evidence for originality is also presented when biological errors in previous cuts are not perpetuated. The husks in the large cut of Fuchs' herbal (fig. 4) are drawn in an unnatural position. Dodonaeus' cut (fig. 8), on the other hand, presents them life-like.

The woodcuts in the forty-seven illustrated herbals surveyed here were traced to originals in seven herbals. Only one cut had been copied extensively. The

[92] Church, *op. cit.*, p. 233.

[93] The detection of a reprint where the original may be unknown is, of course, impossible. Therefore, some of the cuts which have been deemed "original" in this study may not have been original in the work to which they were traced, but may have been reprinted from previous herbals not in the collection of the Missouri Botanical Garden Library.

large cut in the first herbal of Fuchs, the first drawing of maize in the herbals, had such far-reaching influence that a number of cuts for the next hundred years were copied from it. This cut, of folio size, was probably considered too large for reprinting and was reduced in later herbals to 4¾ inches and to 2½ inches. (Since cuts were usually reduced by pantograph, they appear in reverse of the original. See Appendix I). Bock, in his herbal of 1546, presents an illustration of a stalk which is unquestionably a pantograph copy of one of the four stalks in the Fuchs herbal. The 1551 edition of the herbal of Lonicerus contains a cut of a plant with two stalks, taken from the Fuchs cut. Matthiolus, in his herbal of 1570, shows a plant that is very likely a stylization of the one in Fuchs (fig. 3). In addition, the herbal of Bauhin of 1651 gives a pantograph copy of three right stalks of a reduction of Fuchs' cut. A complete trace-list of all cuts in the herbals surveyed is found in Table IV.

All significant biological features were examined in these originals: the number of stalks, the number of ears borne on a stalk, the presence or absence of prop-roots and "flag" leaves, the shape of the ear, the number of rows of kernels, and, where possible, the arrangement of the tassel branching. A description of the cuts follows:

Fuchs, 1542:

Fuchs presents a culm bearing three tillers, two of which have one ear each (fig. 4). The culm bears four ears, the topmost being partially husked and showing eight regular rows of rounded kernels which taper toward the tip. This cut, of folio size, was reduced and used in thirteen later herbals. In the 1545 edition of Fuchs' herbal, the cut was reduced to 4¾ inches in length (fig. 5), but retained all gross features of the original. This reduced cut was also used in the editions of 1595 of the herbal of Fuchs, and of 1552, 1553, 1554, 1563, and 1578 of the herbal of Dodonaeus. The cuts in the editions of 1549, 1551, and 1553 of the herbal of Fuchs were reduced to 2½ inches (fig. 6).

Bock presents in his herbal of 1546 (fig. 7) a simplified copy of the cut in the Fuchs herbal of 1542,[94] which is used in later editions of his herbal (1552 and

[94] The single stalk in Bock's cut is a copy of the third stalk in the cut of Fuchs. Note that the arrangement of the leaves on both stalks is almost identical. (The cut was likely copied by pantograph, and hence all features are in reverse). On both stalks the top leaves are drawn opposite instead of the natural alternate arrangement, the third leaf from the top is incurved and has a small bract-like projection opposite it, and one of the basal leaves is bent around and in back of the stalk. Also, in proportion to the relative sizes, the leaves are drawn in both cuts at approximately the same internodal distance. Both stalks bear four ears. The Bock cut copies the Fuchs presentation of an ear with husks drawn only one-half way in an unnatural position, probably in order to expose the top half of the ear. In both cuts the corn silks are drawn extending from the tip of the ear, rather than from the kernels as actually occurs. The top two ears on both cuts are drawn from one node. Both stalks have ears of eight rows, but the third ear from the top on the Bock cut is husked one-half way, displaying a second ear of eight rows; this ear is covered in the Fuchs drawing. The husk arrangement of these two ears is very similar, however. The lowermost husk on both ears is drawn hanging down and around the lowest stalk. This indicates that Bock's artist possibly recopied the top ear in the third-ear position.

1560) and in the herbal of Valerius Cordus of 1561. Similar but somewhat stylized copies are found in the 1570 and 1583 editions of the herbal of Matthiolus; the 1651 edition of the herbal of Bauhin; the 1656 edition of the herbal of Pancovius; and the 1666 edition of the herbal of Chabraeus.

Dodonaeus, 1566:

The gross morphological features of the plant in the 1566 edition of Dodonaeus' herbal are completely different from those in Fuchs' cut (fig. 8). The tassel branches are firmer and more highly condensed, with a strong central spike. The ears are drawn with husks bearing distinct "flag" leaves—a feature only sketchily drawn in the cut of Fuchs. Inset is an ear of a higher row number than that in the Fuchs cut. The block of Dodonaeus is used in three later editions of the herbal (1583, 1616, 1644), in three editions of the herbal of l'Obel (1576, 1581, 1591), in one edition of Gerarde's herbal (1636), and in one herbal of Parkinson (1640).

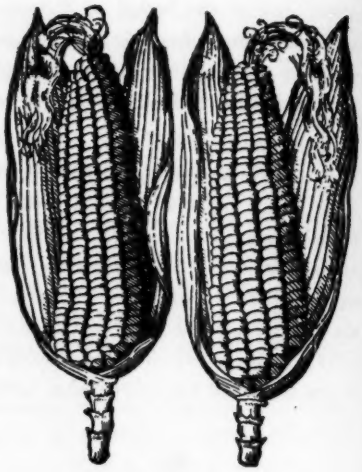
11

Fig. 11. "Turkish Corn" (Plant A) of Tabernaemontanus (1588). Note that the plant is without prop-roots.

12

Fig. 12. "Indian Corn" (Plant B) of Tabernaemontanus (1588). Note the very distinct "flag leaves" and prop-roots.

13



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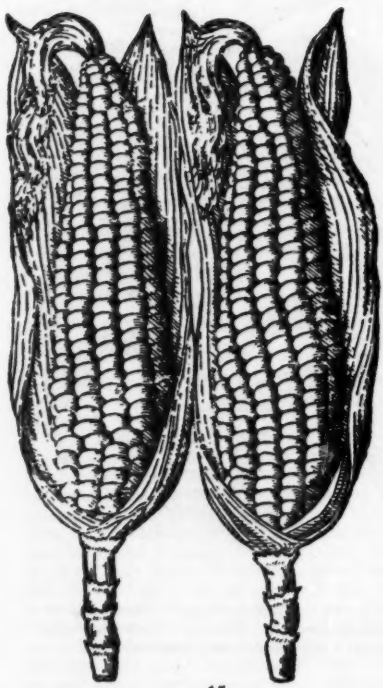

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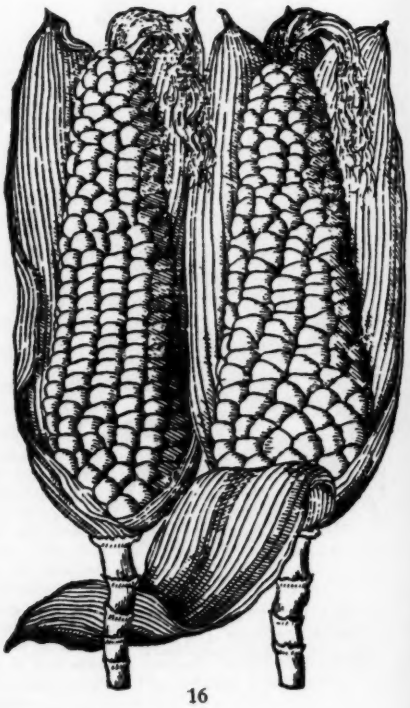
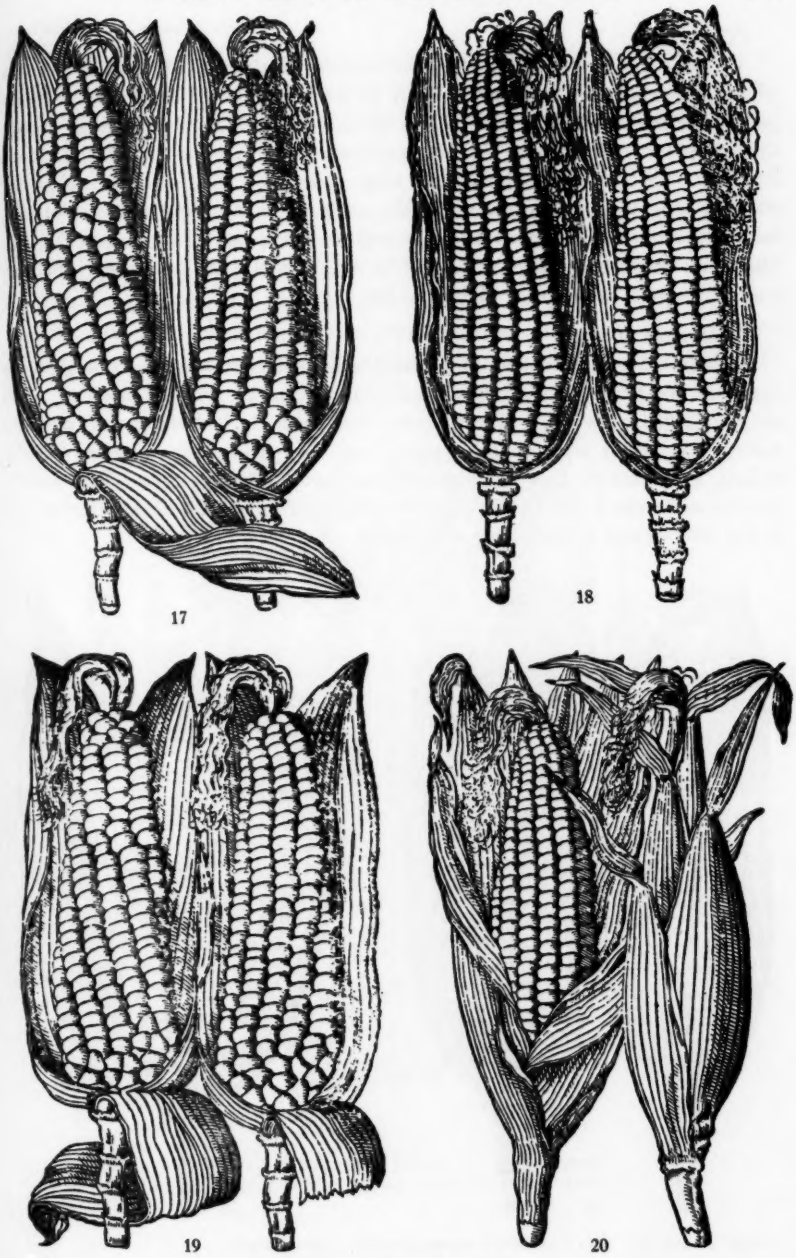


16

Figs. 13–16. Ears in the herbal of Tabernaemontonus (1588):

Fig. 13. "Red Turkish Corn" (left) and "Purple Turkish Corn" (right). Fig. 14. "Yellow Turkish Corn" (left) and "White Turkish Corn" (right). Fig. 15. "White, Brown and Dark Blue Indian Corn" (left) and "Speckled Indian Corn" (right). Fig. 16. "Red and Brown Indian Corn" (left) and "Yellow and White Indian Corn" (right).



Figs. 17–20. Ears in the Tabernaemontanus herbal (1588):

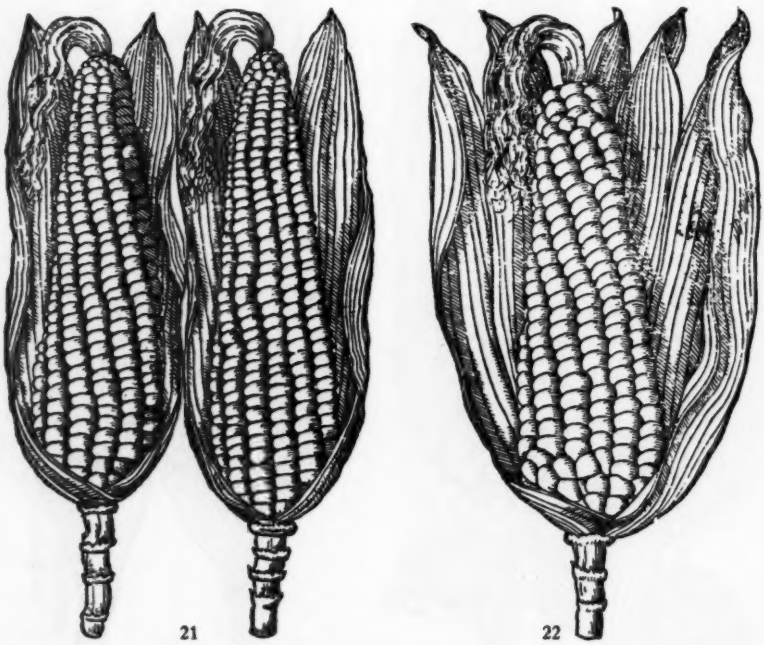
Fig. 17. "Violet-colored Indian Corn" (left) and "Golden Indian Corn" (right). Fig. 18. "White Indian Corn" (left) and "Black Indian Corn" (right). Fig. 19. "Red, Black and Brown Indian Corn" (left) and "White, Violet, Brown and Yellow sprinkled with Brown Dots" (right). Fig. 20. "Ears of Indian Corn."

l'Obel, 1581:

This was the first woodcut to present a stalk with prop-roots (fig. 9). These grow out at the lower nodes of the stalk in most varieties of maize and are conspicuously over-developed, as has been pointed out, when the plant is moved northward from the Tropics. Many features of the plant are highly stylized in this cut. The flag leaves are drawn with flourishes. The tassel branches are pictured as extending from the tip of the culm. The silks flow wavily from the ears. The stalk is bisected, probably in order to fit the whole plant into the cut. This is reproduced in a later edition of l'Obel's herbal (1591), in the herbal of Gerarde (1636), and in that of Hernández (1651).

Camerarius, 1586:

This cut (fig. 10) portrays a dwarfed plant, with an ear showing silks growing out from the kernels, an enlarged tassel branch, and an enlarged spikelet. The ear is of about eight rows. Freak plants were generally looked upon as portents during this period and for this reason they were frequently included in the herbals, even though they were not representative of their type. This cut is reproduced in the 1586, 1611 and 1678 editions of the herbal of Matthiolus and in the 1609 edition of the herbal of Durante.



Figs. 21 and 22. Ears from the Tabernaemontanus herbal (1588):

Fig. 21. "Yellow Indian Corn" and "Brown Indian Corn." Fig. 22. "Yellow, White, also Blue and Violet-Brown, also some Yellow and White Indian Corn Sprinkled with Violet and Blue Dots."

Tabernaemontanus, 1588:

The 1588 edition of the herbal of Tabernaemontanus presents two stalks of maize and 21 ears. One plant (A) (fig. 11), labeled *Frumentum Turcicum,* has three very slim ears without "flag" leaves, has highly condensed tassel branches and no prop-roots. The second plant (B) (fig. 12), named *Frumentum Indicum,* bears three very fat ears, a higher number of tassel branches, and three rows of prop-roots. This plant differs from that portrayed in the l'Obel cut (fig. 9) in its firmer, more natural tassel branches, less artistic flourishes in the corn silks and "flag" leaves, and having fewer rows of prop-roots. Four realistic ears (figs. 13 and 14) are presented under the heading *Frumentum Turcicum* and seventeen (figs. 15–23) under the heading *Frumentum Indicum.* The names for these cuts are reversed in later editions of Tabernaemontanus and in copies in other herbals.

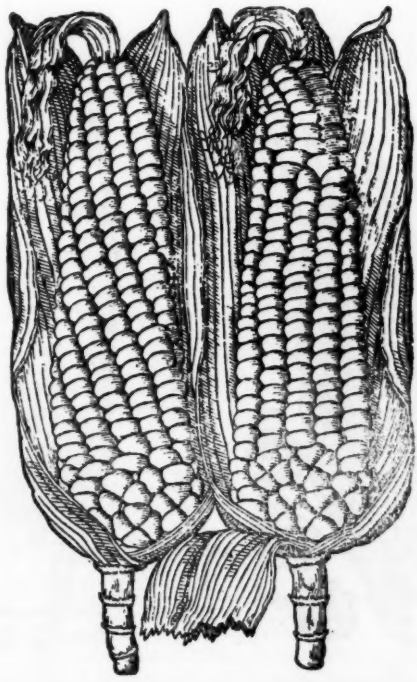


Fig. 23. "Dark Blue, Yellow, White and Speckled with Dark Blue Dots," from Tabernaemontanus (1588).

The cut of Plant A is reproduced in the later herbals of Tabernaemontanus of 1613 and 1664 as *Frumentum Indicum* and in the herbal of Bassaeus of 1590. The cut of Plant B is reproduced in the Tabernaemontanus herbals of 1613 and 1664 as *Frumentum Turcicum,* in the Bassaeus herbal of 1590, and in the herbals of Matthiolus of 1674 and 1698. All the ears are reproduced in the later editions of the herbal of Tabernaemontanus.

Bauhin, 1651:

Bauhin presents a drawing of an ear of about ten rows with silks drawn realistically. Inset are several types of enlarged kernels: long and flat; round and pointed; round and unpointed. (See fig. 24.)

Boccone, 1674:

In his edition of 1674, Boccone shows a freak plant with both the male and female inflorescences growing out from one branch. Like the plant in Camerarius' edition of 1586, this freak was probably presented as a portent. (See fig. 25.)

24

Fig. 24. Illustration of an ear from the herbal of Jean Bauhin (1651), showing enlarged kernels of several types.

25

Fig. 25. A freak maize plant (Boccone, 1674), with both the male and female inflorescences growing out from one branch.

TABLE IV

WOODCUTS OF MAIZE IN THE 16TH AND 17TH CENTURY HERBALS

Herbals containing original woodcuts of maize	Reprints	Reductions	Copies
Fuchs, 1542	None	Fuchs, 1545 Fuchs, 1549 Fuchs, 1549 (Fr.) Fuchs, 1551 Lonicerus, 1551 Dodonaeus, 1552 Fuchs, 1553 Dodonaeus, 1553 Dodonaeus, 1554 Dodonaeus, 1563 Dodonaeus, 1578 Dodonaeus, 1578 (Eng.) Fuchs, 1595	Bock, 1546 Bock, 1552 Bock, 1560 Cordus, 1561 Matthiolus, 1570 Matthiolus, 1583 Bauhin, 1651 Pancovius, 1656 Chabraeus, 1666
Dodonaeus, 1566	L'Obel, 1576 L'Obel, 1581 L'Obel, 1591 Dodonaeus, 1583 Dodonaeus, 1616 Gerarde, 1636 Parkinson, 1640 Dodonaeus, 1676		
L'Obel, 1581	L'Obel, 1591 Gerarde, 1636		Hernández, 1651
Camerarius, 1586	Matthiolus, 1586 Durante, 1609 Matthiolus, 1611 Matthiolus, 1678		
Tabernaemontanus, 1588* (Plant A)	Bassaeus, 1590 Gerarde, 1597 Tabernaemontanus, 1613 Tabernaemontanus, 1674		
Tabernaemontanus, 1588 (Plant B)	Bassaeus, 1590 Gerarde, 1597 Tabernaemontanus, 1613 Tabernaemontanus, 1664 Matthiolus, 1674 Matthiolus, 1678		
Bauhin, 1651	Chabraeus, 1666		
Boccone, 1674			

*Tabernaemontanus presents cuts of 21 ears along with the stalk illustrations. One or two of these are sometimes reproduced, as in the herbal of Gerarde, 1636.

Conclusions

In the literature of exploration, the descriptions of maize are mostly fragmentary and inexact; in the herbals they are generally precise and well illustrated. Although we are now in a position to discuss authoritatively the maize of the herbalists, much more research will be necessary before we can speak with equal authority on the maize of the New World in early post-Columbian times. The literature of exploration is so vast, and bibliographic aids for consulting it are still so few, that it will take years of work to bring the data together for critical consideration. Some conclusions can already be drawn, however. We know that maize was widespread in the New World, was of a variety of types, and was used for various special purposes, such as in brewing, coloring food, for fat and oil, and in ceremonies. These indicate a relatively long use in the hands of skillful cultivators.

What do the herbals contribute to the history of maize? Their chief value is in enlarging our understanding of the types of maize in post-Discovery Europe. Our information in the herbals comes from two sources: text and illustrations. There is not always exact correlation between the two where both appear. As has been pointed out above, the herbalists frequently borrowed or copied each other's woodcuts, and this was done apparently without determining whether the material coincided with their text. Dodonaeus, for example, in his herbal of 1566, describes an ear of eight to ten rows; yet in his illustration he includes an ear which appears to have ten to twelve rows (see fig. 8). Both sources of information, therefore, have to be considered separately in determining their biological significance. Generally it is from the woodcuts, where such detailed items as kernel shape, presence of prop-roots, etc. can be observed, that we get most of our information.

How much of the text on maize is original in each of the herbals is hard to determine. The classical tradition of copying from previous works was especially true of the herbals. Their purpose, it must be remembered, was to allow the reader to associate the particular plants of his region with those medically efficacious plants described by the ancients. For example, in the herbal of Brunfels, the first of the German Renaissance fathers of botany, descriptions are taken verbatim from those of the ancients. With such a tradition, it is not unlikely that the herbalists might have copied from each other descriptions of new plants. A number of characteristics appear much the same in most of the descriptions of maize. Wherever the row number of the ear is mentioned in sixteenth-century herbals, an eight- to ten-rowed ear is described. The growing season likewise is generally the same—late March or April to late August or September. Some of the material, such as the discussion of maize in the herbal of 1570 of Matthiolus, was influenced by the New World chroniclers. The validity and originality of the woodcuts have been discussed above.

The material of most value—both from text and woodcuts—comes from herbals of the sixteenth century. Most of the woodcuts of the seventeenth century

herbals are reprints or copies (See Table IV), and the texts, for the most part, are similar to those of the preceding century. Moreover, in the later period, maize was probably being reintroduced at various times and from various places and the original introductions were probably hybridized.

The information presented here cannot be classified definitively. A comprehensive classification of maize is not yet in existence (see Anderson and Cutler, 1945). For some time to come, a complete and natural classification of the maize of the world must be a project to work toward. Enough has already been done, however, to point to certain significant characters of the corn plant which will help us determine the inter-relationships of various types. From studies of the maize of Mexico (Anderson, '46), of the United States Southwest (Carter and Anderson, '45) and the Northeast (Brown and Anderson, '47), and of Central America (Anderson, '47) it has been learned that the following characteristics are particularly important in tracing the racial history of maize: row number; breadth of culm; number of tassel branches; kernel size and shape (whether pointed or dented); ear shape; leaf width; absence or presence of "flag" leaves, and of prop-roots. With these characteristics in mind, it is clear that there are at least two distinct types of maize discussed in the herbals. In the later herbals, where both types appear, they are distinguished by different names. The first type, that described and illustrated by Fuchs (1542, fig. 4), Dodonaeus (1566, fig. 8), and Tabernaemontanus (*Frumentum Turcicum*, 1588, fig. 11), is without prop-roots. It has an ear of about eight to ten rows, with some "flag" leaves, few tassel branches, and a generally slender culm. These characteristics are similar to those of Northern Flints—a type of maize recently studied and described by Brown and Anderson ('47, p. 2):

> The ears of the northeastern flints are characteristically long and slender with 8–10 rows of wide, crescent-shaped kernels . . . There are usually very few prop-roots above the level of the soil surface. The culms are small and slender with long internodes and are lighter green than most dent varieties. The leaves are narrow and the ears are borne on long shanks. The leaves of the ear shoot (the husks) have conspicuous blades which are sometimes referred to as "flag leaves" by sweet-corn breeders.

The ear in the Fuchs illustration is clearly eight- to ten-rowed—a character also mentioned by Fuchs in his text. The ears described and illustrated by Tabernaemontanus (1588, figs. 13–23) also number about ten rows. The ear in the Dodonaeus woodcut, however, which is inserted without husks at the bottom of the drawing, appears to have a somewhat higher row number (about 12 rows), although in the text he describes it as having eight to ten rows. This ear, strongly tapering and perhaps of the dent type, might very well have been drawn from a different plant from that used as model for the cut. The kernels in the illustrations of Fuchs and Tabernaemontanus are distinctly rounded like flint kernels.

Certainly the most interesting characteristic of this first type of corn is its lack of prop-roots. These develop conspicuously when many (although not all) tropical varieties are moved farther north. The lack of them in all the early plates and in most of the descriptions leads us to wonder if the corn first described

by the herbalists was that introduced from the Caribbean by the Hispanic explorers. These plates and descriptions indicate a type of corn other than those which might most readily have come from the tropical regions of the Caribbean. Both l'Obel (1581) and Tabernaemontanus (1588) present illustrations of this type of maize without prop-roots and distinguish it from another type (discussed below) containing several rows of roots. They label the former *Frumentum Turcicum* (Turkish Corn), and the latter, *Frumentum Indicum* (Indian Corn). Parkinson (1640) points out explicitly that the plant without prop-roots was prevalent in England and that the plant with such roots was a "stranger". Flag leaves, another characteristic of flint corns, are especially noticeable on the plant of Dodonaeus. They are not shown, however, in Fuchs' illustration (where the husks are drawn unnaturally) nor in the *Turcicum* cut of Tabernaemontanus. The other characteristics, a slender culm and a few branches, can only be approximately studied from the illustrations.

At the present time we can only speculate on what type of maize this is. It might have been a Northern Flint, having, as has been pointed out, a number of outstanding similarities. Such speculation naturally starts further questioning as to where this type of maize originated and how it was introduced into Europe. We know from the material in the herbals that it was grown in Germany and the Low Countries at least fifty years after the Discovery of America. The herbalists generally claimed that it came from the Orient. Fuchs (1542) says it was brought into Germany from Greece or Asia. Dodonaeus, in early editions, calls the plant *Milium Indicum* and associates it with the plant of Pliny, but in his edition of 1566, where his own drawing is first presented, he concludes that the plant is unlike anything described by the ancients. Tabernaemontanus expressly distinguishes this type, which he labels *Frumentum Turcicum*, from another which he calls *Frumentum Indicum* and which he says was brought in from the New World. He makes no mention of the possible origin of the *Turcicum* plant but from the name he very likely assumed an Oriental origin.

How a Northern Flint type might have reached Europe at such an early date can only be guessed. It is known that the Northern Flints described by Brown and Anderson were widespread in eastern North America in pre-Columbian times. According to legend, two Norsemen, Karlsefn and Thorfin, in the years 1002 and 1006 A.D., brought back ears of corn to Europe from what is now Massachusetts (Bowman, '15, p. 1). Could this be the maize that found its way in the gardens of the herbalists? Or could it have been from a plant possibly brought into Europe during the first quarter-century after the Discovery by some English explorers—especially since Parkinson (1640) reports that the corn without prop-roots was most prevalent in England? If not, then it might be some variety, as yet unstudied, from the Caribbean, without the conspicuous characteristic of prop-roots. Such varieties have recently been discovered in the Amazon basin by Cutler, but as yet these types have not been reported from the Caribbean. Maize from this area was very probably introduced by many of the Hispanic explorers or even

by Columbus himself. It could easily have reached Germany from Spain quite early as both were part of the empire of Charles V and there was extensive trading between the two countries.

The second type of maize, illustrated by l'Obel (1581, fig. 9) and by Tabernaemontanus (1588, fig. 12), seems to be one of the common corns from the Caribbean area. It has a number of similarities to maize of this tropical region. As usually occurs when these plants are moved out of the tropical zone north into the temperate zone, several rows of prop-roots sprout from the lower nodes. The ears depicted by Tabernaemontanus tend to be higher-rowed, another characteristic of these corns. Both l'Obel and Tabernaemontanus make a distinction in their illustrations between this type and that described above. This type is labeled in both herbals "Indian Corn," and its origin, according to Tabernaemontanus, is America. L'Obel, on the other hand, believed that it was similar to the plant described by Pliny. Such a maize was very probably introduced into Europe by the Hispanic explorers and reached Germany by the routes discussed above.

Summary

We now know that two general types of maize are discussed in the herbals. The first type, which was first illustrated fifty years after the discovery of America (Fuchs, 1542), is similar to the typical flints of eastern North America and was believed by most of the herbalists who discussed it to have been brought into Europe from Asia. Where such a type of corn actually came from can only be speculated upon. It may be some as-yet-unknown tropical variety closely related to our flints, but the final answer will have to await further study. The second type of maize, recognized by herbalists in the latter half of the sixteenth century as different from the first and reported by them to have been brought in from America, is much like the present-day corn of the Caribbean area and was very likely introduced into Europe by the early Hispanic explorers.

APPENDIX I

THE WOODCUTS OF THE GREAT HERBALS

All of the illustrations in the herbals were printed from wood blocks. A knowledge of how woodcuts are made, how they differ from other graphic processes, and how they can be copied is helpful in understanding much of the data on maize in the herbals.

Historical Background of Woodcuts.—

As early as 1041, woodcuts were used by the Chinese to illustrate books. In Europe before the discovery of the printing press, there was a wide use of block-books in which both text and illustrations were printed from woodcuts.[95] In the century after the discovery of the printing press, woodcuts found their widest use and attained the peak of their artistic development as decorations and illustrations of the printed text. Woodcuts produce prints from an inked surface in relief, as does type. Both the cut and the type could be inked at the same time and, where desired, both could be used on the same page. Intaglio printing, on the other hand, which is not in relief, requires a separate inking and cannot be produced on the same page with the printed text.

How Woodcuts Are Made.—

In making a woodcut, the cutter worked from a design which was drawn, traced, or pasted directly on the wood block, generally about ⅞ inch thick. The parts of the block surface which were to print white were cut away, leaving the parts to print black in relief.[96]

There are two general types of woodcuts: the black-line and the white-line. All of the woodcut illustrations in the herbals are of the black-line type. The relief of the black-line cut is intended for the design itself, printing a black-line drawing against a white ground. In making this type of cut, the cutter merely cuts away from lines of a design drawn or pasted on the wood block. In the early period of the craft this work was often done by woodcutters who belonged to the class of the carpenter rather than to that of the artist.[97]

How Woodcuts Differ from Other Graphic Processes.—

Woodcuts differ from other illustrations in that the part of the block that is inked for printing is in relief. In intaglio engravings and etchings, on the other hand, the part inked for printing is cut into the surface. In lithography the printing is from the surface without relief or indentation.

Lithography was not known during the 16th and 17th centuries, so the woodcuts of this period have chiefly to be distinguished from metal relief cuts and intaglio-line engravings. Prints from the few metal relief cuts can be detected sometimes by the outline of the nails which fastened the metal plate on the wood

[95] Hind, Arthur M., *History of woodcuts*, pp. 35, 65–66.
[96] *Ibid.*, p. 7.
[97] *Ibid.*, p. 30.

block.[98] Prints made from woodcuts are impressed in the paper surface and in this way can generally be distinguished from intaglio prints which are raised slightly above the surface. A print from a woodcut does not show an outline of the boundaries of the block, as does that from an intaglio plate. The woodcut line is generally broader and less regular than the engraved line. Each side of the woodcut line has to be cut separately, but the engraved line is made by a single push of the burin and can be drawn very fine. The engraved line always ends in a point, while the woodcut line can be made either blunt or pointed at the ends, depending on the style of the artist.

Botanical Woodcuts.—

Botanical illustration, although gaining its greatest impetus from the woodcut, certainly did not begin with that graphic technique. Hand-painted illustrations of plants were used very early. Pliny reports that the herbal of Krateuas, who lived around 120 B.C., contained colored pictures of plants.[99] The famous Anicia Juliana Codex of Dioscorides (512 A.D.), which is still in existence, is similarly illustrated.[100] In fact, the early herbals were generally illustrated in this manner. Drawings such as these, copied and recopied throughout the Middle Ages, served as models for the first botanical woodcuts. The earliest book of this kind, *Das puch der natur* (The Book of Nature) of Konrad von Megenberg, printed in 1475, had been compiled three centuries earlier. The work had been widely copied before it was printed, since 35 manuscripts still exist.[101] The *Herbarum* of Apuleius Platonicus, which was published with illustrations in 1481, also had been copied and recopied for a long time, its possible origin dating as far back as the fifth century.[102] With each copying, the illustrations in these early herbals withdraw farther and farther from nature. The first botanical woodcuts, as a result, are little more than diagrams of the general appearance of plants and are often unrecognizable. Exact details of the plant, such as type of venation or peculiarities of leaf shape, are omitted.

The renaissance of botanical illustration started with the publication of Brunfels' *Herbarum vivae eicones* in 1530. The work is significant because its 135 woodcut illustrations were designed from actual plants. It was one of the first works to present pictures which even now retain their value as accurate scientific documents. Brunfels wrote at the beginning of his work:

> I have no other end than that of giving a prop to fallen botany; to bring back to life a science almost extinct. And because this has seemed to me to be in no other way possible than by thrusting aside all the old herbals, and publishing new and really life-like engravings, and along with them accurate descriptions extracted from ancient and trustworthy authors, I have attempted both . . .[103]

The realistic drawings in the work are important because they depict plants

[98] Ivins, *How prints look.* New York, 1943, p. 39.
[99] Arber, *op. cit.*, p. 8.
[100] *Ibid.*, p. 9.
[101] *Ibid.*, p. 14.
[102] *Ibid.*, p. 15.
[103] Greene, *op. cit.*, p. 172, as quoted from Brunfels.

whose morphology and anatomy were little known at the time the herbal was compiled. Little could be said about botany by earlier herbalists because little was known. Little could be described because few words had been created to describe botanical organs. The descriptions that were used had been copied mostly from the works of Greek and Roman writers handed down for more than 1000 years. Yet by means of realistic depiction, Brunfels was able to project the first important botanical message of the renaissance. And through use of the woodcut, the message was circulated widely—not only among physicians but also among students of the gradually developing new science of botany. The descriptions that could not be expressed in words were communicated in a more graphic fashion —a depiction in detail of the actual plant itself.

The realistic depiction of plants was continued on a larger and more elaborate scale in the herbal of Fuchs, *De historia stirpium* (1542). Of folio size, this edition contains 500 drawings 13 x 8 inches. Fuchs' herbal is especially significant in this study because it contains the first illustration of maize to be found in the herbals and among the first drawings of the plant to be published in Europe.

Copying Woodcuts.—

In a period when illustrations were expensive and plant models for woodcuts sometimes hard to get, woodcuts were frequently copied or borrowed by one herbalist from another. Copying a cut of the same size entailed merely tracing the design through transparent paper and pasting the paper on the block for cutting. Cuts were commonly reduced or enlarged by means of a pantograph—a device with a pen at each end, one being used to trace the design to be copied, the other attached to a hinged mechanism. This mechanical arm could be extended for reducing and closed for enlarging—copying the tracing mechanically in reverse of the original.

Many of the large cuts in Fuchs' herbal of 1542 were reduced by pantograph in later editions and published in reverse of the original. Other reductions, however, which had the design printed in the same position as in the original, were made by turning over the paper on which the design was pantographed before pasting it on the cut.

Appendix II

PASSAGES FROM ORIGINAL TEXTS QUOTED AND TRANSLATED

The following passages are the original text of the footnotes so numbered:

[10]Este pan tiene la caña e asta en que nace tan gruessa como una asta de una lança gineta: y alguna como el dedo pulgar e algo mas e menos segun la bondad dela tierra do se siembra. E crece comunmente mucho mas que la estatura de un hombre: e la hoja es como de cana comun de Castilla: y es mucho mas luenga e mas ancha e mas domable y mas verde e menos aspera. E cada una caña echa a lo menos una maçorca: e algunas dos e tres: e ay en cada maçorca cc e a un.o. (sic ?) e mas y menos granos segun la grandeza dela maçorca. E cada maçorca esta embuelta en tres o quatro hojas o cascaras juntas e justas al grano unas sobre otras algo asperas: e quesi de la tez o genero de las hojas de la caña en que nace: y esta tan guardado el grano por aquellas cortezas o cascaras que lo cubren . . .

[11]Como soy amigo de la leçion de Plinio, diré aqui lo que diçe del mijo de la India, y pienso yo que es lo mismo que en estas nuestras Indias llamamos mahiz, el qual auctor diçe aquestas palabras: "De diez años acá es venido mijo de la India, de color negro de grande grano: el tallo como cañas, cresçe siete piés: es dicho lobas é es fertilíssimo sobre todas las cevadas: de un grano nasçen tres sextarios: siémbrasse en lugares húmidos." Por estas señas que este auctor nos da, yo lo avria por mahiz, porque si diçe que es negro, por la mayor parte el mahiz de Tierra-Firme es morado escuro, ó colorado, é tambien hay blanco, é mucho dello amarillo. Podria ser que Plinio no lo vido de todas estas colores, sino de lo morado escuro que paresçe negro. El tallo que diçe que es como cañas, assi lo tiene el mahiz, y quien no lo conosçiesse e lo viesse en el campo, quando está alto, penssará que es un cañaveral. Los siete pies que diçe que cresçe, por la mayor parte acá es el mahiz algo mas alto, y tambien mucho mas, y en partes menos, segund la fertilidad ó bondad del terreno en que se siembra. Quanto á lo que diçe de ser fertilíssimo, ya he dicho lo que he visto, que es coger ochenta e çiento e çiento e cinquenta hanegas de una de sembradura: diçe que siembra en lugares húmidos: humidíssima tierra son estas Indias. Mas para comprobar la nescessidad que el mahiz tiene de estar puesto en tierra húmida, ó donde el agua le sea propiçia, digo que estando en Avila la Magestad de la Emperatriz, nuestra señora, á la saçon que el Emperador, nuestro señor, estaba en Alemania, vi en aquella cibdad, que es una de las mas frias de España, dentro de una casa, un buen pedaço de mahizal de diez palmos de alto las cañas, é algo mas é menos, é tan gruesas é verdes é hermosas, como se puede ver en estas partes, donde mejor se pueda haçer; y alli á par ténia una anoria de que cada dia le regaban. Y en verdad yo quedé maravillado, acordándome de la distançia y de los diferentes climas destas partes con Avila, y porque los testigos que diere desto, sean apropóssito mio, digo que en la misma casa possaba el muy reverendo señor doctor Bernal, del Consejo Real de Indias por Sus Magestades, é que agora es obispo de Calahorra, lo qual fué el año de mill é quinientos é treynta de la Natividad de Chripsto, nuestro Redemptor.

[11]*Pliny's original text:*

milium intra hos X annos ex India in Italiam invectum est nigrum colore, amplum grano, harundineum culmo. adolescit ad pedes altitudine VII, praegrandibus comis—iubas vocant—, omnium frugum fertilissimum. ex uno grano sextarii terni gignuntur. seri debet in umidis. (*Plini Secundi Naturalis Historiae Libri XXXVII*, Vol. III, Lipsiae, 1892, *Lib.* XVIII, *Cap.* 7, p. 157.)

The confusion between Oviedo's term *lobas* and Pliny's *iubas* was probably a textual misinterpretation.

[13]De un grano nasce una caña solamente; empero muchas veces una caña lleva dos y tres espigas, y una espiga cien granos y docientos, y aun cuatrocientos, y tal hay que seiscientos. Cresce la caña un estado y mas, engorda mucho, y echa las hojas como nuestras cañas; pero mas anchas, mas largas, mas verdes y mas blandas . . . Viene a sazón en cuatro meses, y en algunas tierras en tres, y a mas y medio en regadío, mas no es tan bueno.

[16]Tampoco tenían trigo en todas las Indias, que son otro mundo; falta grandísima segun la usanza de acá mas empero las naturales de aquellas partes no sintían ni sienten tal falta, comiendo pan de maíz, y cómenlo todos . . . Para comer pan cuecen el grano en agua, estrujan, muelen, y amásanlo; y, o lo cuecen en el rescoldo, envuelto en sus hojas, que no tienen hornos, o lo asan sobre las brasas; otros lo muelen el grano entre dos piedras como mostaza, ca no tienen molinos; pero es muy bien trabajo, así por la dureza como por la continuación, que no se tiene como el pan de trigo; y así, las mujeres pasan trabajo en cocer cada dia; duro pierde el sabor y enderescese presto, y a tres dias se mohesce y aun pudre. Ensucia y daña mucho la dentadura, y por eso traen gran cuidado de alimpiarse los dientes.

[18]Todos por la mayor parte beben agua, pero á ninguno desplaçe el vino: antes son muy amigos dél, é aqueste haçen del mahiz, segund la cantidad que quieren haçer de *chicha*, que assi llaman á su vino, é para haçerlo tienen esta forma. Ponen el mahiz en remojo, é assi está hasta que allí en el aqua comiença a brotar por los peçones, é se hincha, é salen unos cogollicos por aquella parte quel grano estuvo pegado en la maçorca que se crió; é desque está assi saçonada, cuécenlo en buen agua, é despues que ha dada çiertos hervores é menguado la cantidad que ya ellos saben ques menester, apartan del fuego la olla ó tinajuela en que lo cueçen, é repóssase é assiéntase abaxo el grano. É aquel dia no está para beber: pero el segundo dia está mas asentado, é comiençan á beber dello, aunque está algo espesso: é al terçero dia está bueno é claro, porque está de todo punto assentado, y el quarto dia muy mejor, é la color dello es como la del vino coçido blanco de España, y es gentil brevage. El quinto dia se comiença a açedar, y el sexto más, y el séptimo es vinagre, é no para beberse . . .

[22][los indios] beben tanta cantidad [del brebaje de maiz] que los emborracha; y para ese efecto se juntan en cuadrillas en casas particulares, haciendo unas danzas y bailes con atambres y instrumentos torpes; y es costumbre que nunca bebe ninguno destos indios esta bebida solo, sino que tienen todos los vasos a pares, y habiendo de beber el uno en uno de los dichos vasos, ha de dar de beber al compañero en el otro . . . .

[33]Aquel dia ú otro adelante de la fiesta . . . cogen muchos manojos de mahiz atados, é pónenlos alrededor del monton de los sacrifiçios é allí primero los maestros ó saçerdotes de Luçifer, que están en aquellos sus templos, é luego el caçique, é por órden los prinçipales de grado en grado, hasta que ninguno de los hombres queda, se sacrifican é sajan con unas navajuelas de pedernal agudas las lenguas é orejas y el miembro ó verga generativo (cada qual segund su devoçion), e hinchen de sangre aquel mahiz, é despues repártenlo de manera que alcançe á todos, por poco que les quepa, é cómenlo como por cosa muy bendita.

[53]Hoc frumentum, ut alia multa, ex eorum est genere quae aliunde ad nos translata sunt. E Graecia autem & Asia in Germania venit, unde Turcicum frumentum appellatum est: Asiam enim uniuersam hodie Immanissimus Turca occupat Germani etiam ad loca unde affertur respicientes, *Turckisch korn* nominant.

[56]Radicibus nititur multis, obliquis et fibratis, quibus etiam accedunt fulcra quaedam ab imo geniculo undique exeuntia, et in terram demissa, quibus vento agitata seges sustentatur . . .

[61]Hac aetate frumentum Turcicum, aut Saracenicum nominatur: inde quod ex Asia aut Graecia, quae Turcarum imperio modo parent, advectum existimetur . . . . . .
. . . his ipsis frumentum Turcicum dissimile sit, non triticum Bactrianum, sed nouo tritici Turcici nomine potius nuncupandum, donec vetus eius nomen Oedipus aliquis demonstrarit, qui a veteribus alicubi descriptum, aut cognitum fuisse, persuadere queat.

[62]Haudquaquam ex Asia que Turcorum Imperatori paret, (ut a plurisque et vulgo creditum est) aut ex Oriente, sed ab Occidente et ex America, vicinisque insulis, in Hispaniam primum, deinde in alias Europae provincias invectum.

[66]Potest inter Tritici genera quoque recenseri illud frumenti genus, quod quidam perperam Turcicum appellant. Perperam, inquam, quod Indicum, non Turcicum, vocari debeat. Nam ex occidentalibus Indiis primo allatum est, non ex Turcia, et Asia, ut credidit Fuchsius.

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OVIEDO, 1535.

. . . ponense cinco o seys indios .. . uno desuiado del otro un passo en ala puestos y con sendos palos o macanas en las manos y dan un golpe en tierra con aquel palo de punta e meneanle porque abra algo mas la tierra y sacan le luego. E en aquel agujero que hizo echan con la otra mano siniestra quatro o cinco granos de Mahiz que saca de una taleguilla que lleva ceñida o al cuello e con el pie cierra el hoyo con los granos porque los Papagayos e otras aves no los coman. E luego dan otro passo adelante e haze lo mesmo y desta forma a compas y prossiguiendo de un tenor: en ala todos aquellos indios siembran hasta que llegan al cabo dela haça o tierra que siembran e dela misma guisa bueluen al contrario e dan la buelta sembrando hasta que hinchen toda la haça e la acaban de sembrar . . . (folios 71–72).

MATTHIOLUS, 1570.

Serunt Indi hoc semen, quod Malitz vocant, hoc modo. Descendunt in agrum aliquot simul, recta linea dispositi, aequaliterque distantes, et deinde acuto palo terram perforant dextra manu et statim quatuor quin queve grana sinistra manu in unum quodque; foramen conjiciunt, pede altero foramenta occludentes, ne Psitaci semen depascantur. Et ita seriatim passu suo distantias metientes, agrum totum semine replent retrocedentes. Verum anteaquam semen terrae credant, biduo id aqua macerant, nec serunt, nisi prius terra pluvia maduerit. Nascitur infra paucos dies, e quarto in India demetitur mense (p. 305.)

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